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ABSTRACT

This book is designed to help college students with the process of planning a chemistry career by refining their general interests in chemistry into specific education and career objectives. This booklet discusses: (1) what career options are available to students; (2) what kind of academic preparation is required for various chemistry careers; (3) how to organize a job hunt successfully and find a job; and (4) where to find more information on chemical education, job hunting, and chemistry careers. Sources of chemistry education and career information materials available from the American Chemical Society (ACS) are mentioned throughout. (KHR)

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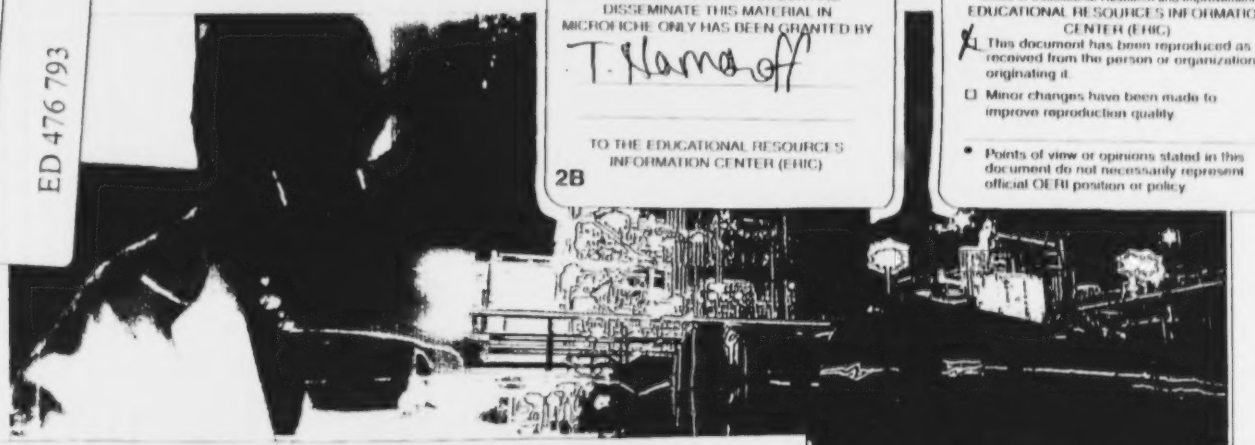

FUTURES THROUGH CHEMISTRY

CHARTING A COURSE

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FUTURES THROUGH CHEMISTRY

CHARTING A COURSE

THE AMERICAN CHEMICAL SOCIETY
Division of Education and International Activities
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TABLE OF CONTENTS

Foreword	iv
Chemistry: Your Path to Many Destinations	1
Chemistry Careers in Industry	5
Chemistry Careers in Government	17
Chemistry Careers in Education	21
Educational Preparation for Careers in Chemistry	27
Graduate School Considerations	37
Job Hunting	41
Conclusion	47
Appendix 1: Conducting a Self-Assessment	49
Appendix 2: Additional Resources	59

FOREWORD

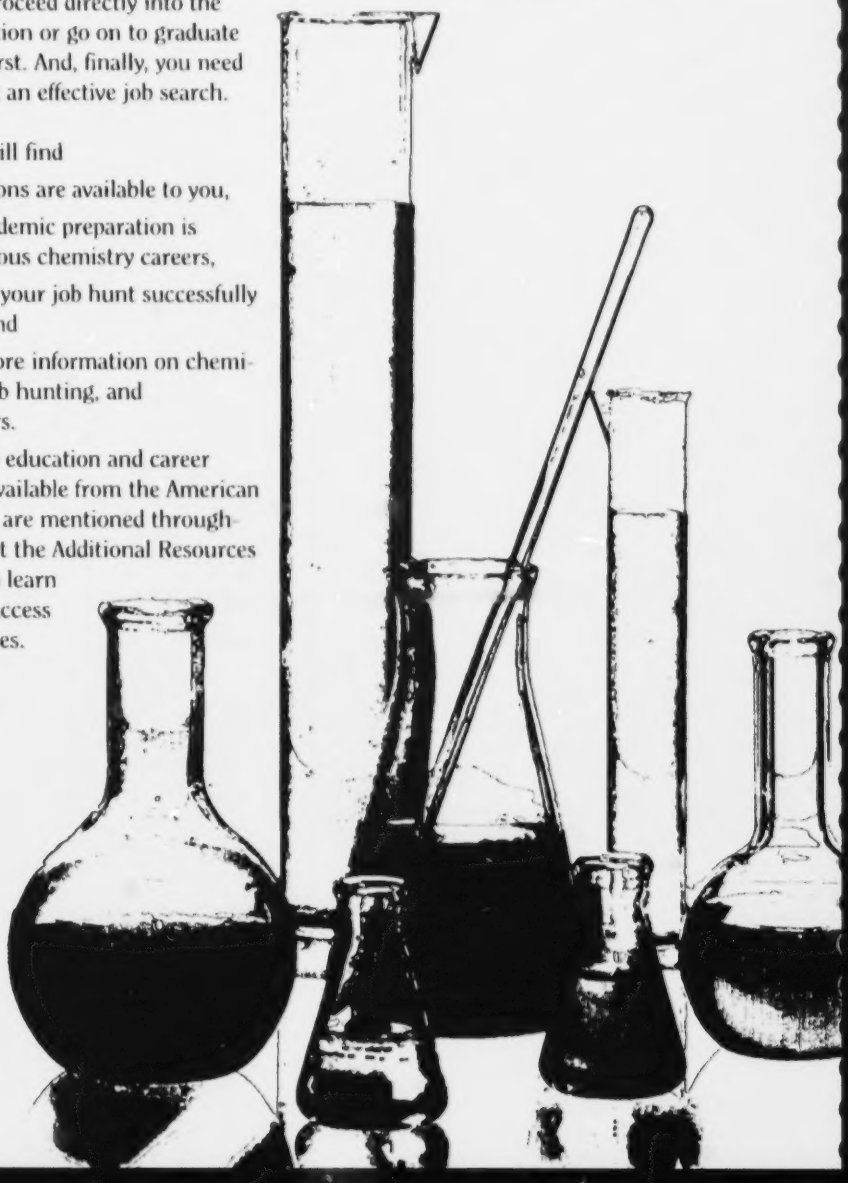
Many career options are available to those who obtain degrees in the chemical sciences. If you are a college student majoring in chemistry or a high school student contemplating a chemistry major, you will soon face decisions about what kind of career path to choose. This booklet was written to help you with the process of planning a chemistry career by refining your general interest in chemistry into specific education and career objectives. Proper preparation while you are still in school can greatly improve your success in getting off to a good start in your professional life.

What does "preparation" for a career mean? First, you need to find out what options exist in the world of work for those with chemistry backgrounds and what courses or other educational experiences will best equip you for specific types of work. Then you have to assess your own skills and interests to determine what areas of work are likely to suit you best. You must also determine whether to proceed directly into the job market after graduation or go on to graduate or professional school first. And, finally, you need to know how to conduct an effective job search.

In this booklet you will find

- ☐ what career options are available to you,
- ☐ what kind of academic preparation is required for various chemistry careers,
- ☐ how to organize your job hunt successfully and find a job, and
- ☐ where to find more information on chemical education, job hunting, and chemistry careers.

Sources of chemistry education and career information materials available from the American Chemical Society (ACS) are mentioned throughout this booklet. Consult the Additional Resources section in Appendix 2 to learn how you can obtain or access these information sources.



1 CHEMISTRY: YOUR PATH TO MANY DESTINATIONS

The study of chemistry is excellent preparation for many careers, both scientific and otherwise. Chemistry is the study of substances in our world, such as the paper and ink of this booklet, the food we eat, the clothes we wear, the gasoline we use in our automobiles, and the rubber in our tires. Chemistry is the central science and involves all other sciences. In fact, many careers that are considered to be in other areas—for example, biology, such as biotechnology (e.g., manipulating living organisms to manufacture products), or physics, such as materials science (e.g., carbon-fiber-reinforced ski poles)—are applied chemistry.

Fairfax County Public Schools, South Lakes High School

Mobil Corporation

Because the study of chemistry imparts skills and knowledge that are valued in the job market, the employment outlook for chemists is usually optimistic. A recent U. S. Labor Department Bureau of Labor Statistics study, "Employment Outlook: 1996–2006," predicts that 36,000 jobs for chemists and 22,000 jobs for chemical engineers will open up over the decade 1996–2006 with 17,000 and 8,000 of those jobs, respectively, being new jobs. Of course, the same kinds of economic forces that affect hiring in other employment areas can affect hiring of chemists as well. Job opportunities may be better in some years than in others.

The chemistry careers we often think of first are teaching in high schools, colleges, and universities and conducting laboratory research in industry, government, and other research institutions. Doing research is often an important part of chemistry faculty positions in colleges and universities. Industries employing large numbers of chemists include chemical manufacturing, pharmaceuticals, construction materials, fertilizer, food, metallurgical materials, oil, and paper. Significant numbers of chemists also work in industries that make consumer and industrial products. These include the automotive industry; companies manufacturing cosmetics and household and industrial cleaning products; the appliance industry; companies manufacturing plastics, polymers and resins used in making paints and polishes, and binders used in many products such as

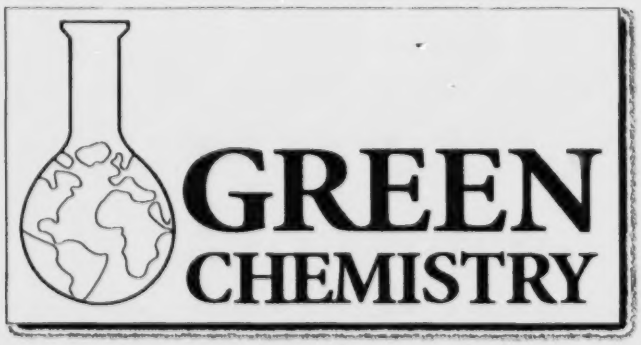
Some Industries That Have Grown Rapidly To Become Major Employers of Chemists

- ☐ **Chemical synthesis**—the efficient conversion of raw materials (such as minerals, petroleum, natural gases, coal, and biomass) into more useful molecules and products.
- ☐ **Chemical catalysis**—processes by which a relatively small amount of foreign material augments the rate of a chemical reaction without being consumed in the reaction.
- ☐ **Bioprocesses, biotechnology, and biocatalysis**—processes using biological organisms in the development of useful products, including chemical products. Bioprocesses have been used since humans first made cheese, leavened bread, fermented wine, and brewed spirits. Biotechnology is being used to make pest-resistant plants and pharmaceuticals. Biocatalysis has been important since we first used enzymes.
- ☐ **Materials technology**—development of new synthetic materials and replacement of traditional materials such as metals, wood, glass, and natural fibers with synthetic polymers and composite materials.
- ☐ **Computational technologies**—a broad range of applications from molecular modeling to process simulation and control.
- ☐ **"Green chemistry"**—a new approach to pollution prevention through the environmentally conscious design of chemical products and processes. By reducing or eliminating the use or generation of toxic substances associated with a particular synthesis or process, chemists can greatly reduce risks to human health and the environment.

paper towels or diapers. Substantial numbers of chemists work in local, state, and federal government research in forensics laboratories and agencies such as the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Armed Forces, and the State Department.

Today, academic and government laboratories predominate in doing basic research whereas industry concentrates on applied research. Basic or "fundamental" research is done just because the problem is interesting whereas applied research is carried out to solve a practical problem, fill a need, or create a marketable product. Both basic and applied research are needed, and much applied research is based on principles and ideas "discovered" while doing basic research.

Though laboratory research is the traditional career of chemists in industry, not all chemists working in industry are active researchers, that is, research bench chemists. Some are bench chemists doing analysis and testing, and some do research but not in the laboratory. Some chemists become information scientists who do their work largely using computers to search online databases and specialize in locating information for their colleagues. In computer departments, chemists do computer modeling, process automation, software development and evaluation, and aid bench chemists in experiment design and analysis (statistics). Still other chemists work in varied areas such as chemical sales, marketing, technical writing, or industrial hygiene in which their chemistry backgrounds are an important factor. In industry and government, chemists may become managers and executives, overseeing production facilities and businesses as well as research groups or entire laboratories.

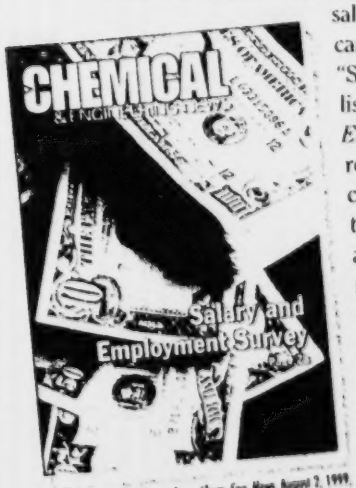


Planning Your Career

Eventually you will complete your formal education (at least temporarily) and enter the job market. The employment outlook for chemists varies with the state of the economy, the prosperity of particular industries, the needs of specific employers, and the amount of government spending on science programs. Specifics of your own situation will also affect how many employment opportunities you will find in the job market. These specifics include

- your education level;
- your technical specialty;
- skills and traits such as communications skills, business sense, ability to work as part of a team, leadership skills, initiative, and versatility;
- geographic restrictions on relocation; and
- previous job and practical experience. (In addition to previous job and research experience, this can include professional society activities, college extracurricular activities, and volunteer work.)

Use the information in this booklet to help navigate the course of your career planning. Also draw upon the additional career resources the ACS provides such as volunteer career consultants, résumé review, mock interview sessions, and publications on targeting the job market as well as many other topics. A list of these services is included in Appendix 2 of this booklet. Current salary information for chemists can be obtained from the ACS "Salary Survey," which is published annually in *Chemical & Engineering News*. This lengthy report breaks down salaries by chemical specialties; job functions such as research or management; type of employer such as industry, academia, and government; degree level; gender; and years since graduation. The "Employment Outlook," also published annually in *Chemical & Engineering News*, includes starting salary information, discussion of the current state of the job market, and forecasts of employment trends. These reports are based on surveys of ACS members and discussions with employment experts.



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The time you spend in preparation will reward you for years to come with an exciting and satisfying career choice.

Chemical Careers in Brief

As a supplement to this guide to careers in the chemical sciences, the ACS Division of Education and International Activities has developed a series of brochures entitled *Chemical Careers in Brief* that presents an overview of a variety of careers in specific areas of the chemical sciences. The series is a collection of 30 briefs, two to four pages long, each focusing on a different career area. The first page of each brief contains an overview of the career area and includes interviews with chemists at all degree levels working in that specific career area in various positions in industry, government, and academia. The chemists interviewed share their experiences working in the field and give examples of the types of positions held by professionals in that career area. The four-page briefs contain personal profiles of the chemists interviewed and of other professionals in the field with more in-depth descriptions of their actual work functions. The last page of each brief, called the Fact File, includes information on working conditions, educational requirements, employment outlook, salary averages, and the skills needed to pursue a career goal in the specific area.

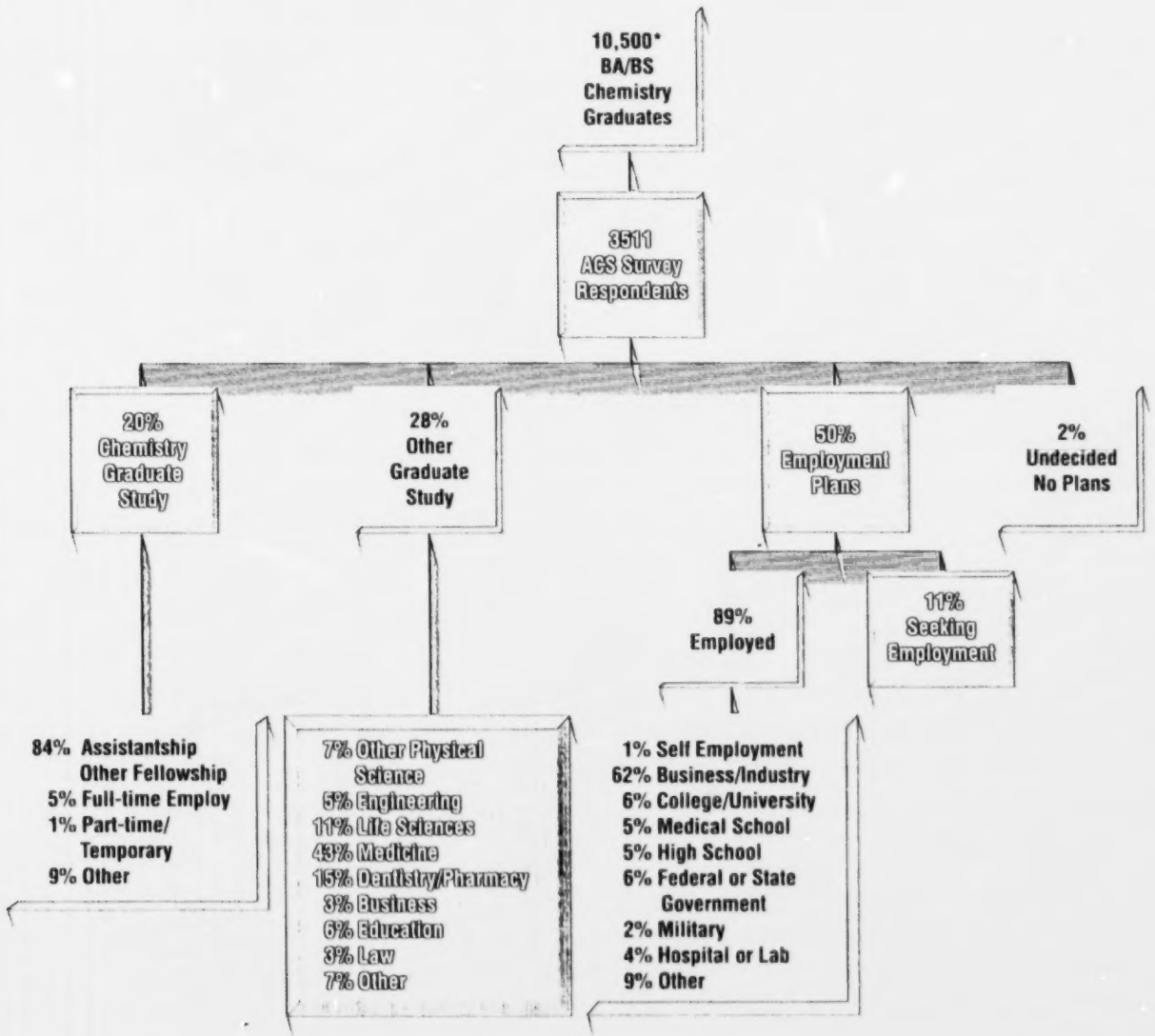
The briefs cover the following career areas: agricultural chemistry, analytical chemistry, biochemistry, biotechnology, catalysis, chemical education, chemical engineering, chemical information, chemical sales and marketing, chemical technology, colloid and surface chemistry, consulting, consumer products, environmental chemistry, food and flavor chemistry, forensic chemistry, geochemistry, hazardous waste management, inorganic chemistry, materials science, medicinal chemistry, oil and petroleum chemistry, organic chemistry, physical chemistry, polymer chemistry, pulp and paper chemistry, R&D management, science writing, textile chemistry, and water chemistry.

To obtain a free copy of any brief, call ACS at (800) 227-5558. Additional information on ordering briefs and other ACS career materials can be obtained from the ACS Education Web site, **www.acs.org**.

Figure 1 shows the plans of the 1998 chemistry bachelor's degree recipients. Of those bachelor's degree chemistry graduates who planned further studies in another discipline in 1998, the choice of field of study has not changed appreciably in the last decade, with studies in the medicine-related fields topping the list. Of those chemistry graduates who chose immediate employment, the majority chose industrial employment.

FIGURE 1

Postgraduation Plans of 1998 Bachelor's Degree Chemistry Graduates



2 CHEMISTRY CAREERS IN INDUSTRY

Private industry employs about two-thirds of all chemists. Industry offers excellent salaries and benefits and many different career paths for chemists. Many industrial chemists work in research and development (R&D), sales, or marketing. Entry-level bachelor's degree chemists may work with senior researchers in R&D laboratories as chemists or technicians or in plant labs analyzing and testing products. As they gain experience, they work more independently and can advance to supervisory positions or change career tracks to work in chemical sales, regulatory, or other business functions.

Chevron Services Company, a Division of Chevron USA, Inc.

Continuing education greatly aids in career track mobility. Taking a minor in business or marketing can aid bachelor's degree chemists in beginning their careers with a sales or marketing job. For those interested in a second degree such as a Master of Business Administration (M.B.A.), one option is to take a position with your chemistry degree and then use your employer's tuition reimbursement program to get the M.B.A. This option allows you to save money and accumulate valuable on-the-job experience in chemistry while getting the second degree.

People working in business management, marketing, sales, and other areas rely on their chemistry background to communicate with customers and understand their problems and product needs. Their chemistry education also enables them to communicate with their own company's researchers and plant personnel with whom they work on teams. The undergraduate chemistry degree is marketable in many different occupations and work environments. In their careers, business managers, marketing personnel, sales representatives, information scientists, computer specialists, patent attorneys, environmental specialists, technical writers, and others definitely do not leave chemistry behind! The ACS Department of Career Services has published a book, *Careers for Chemists: A World Outside the Lab*, that profiles dozens of professionals who have used their chemistry training as a springboard for careers outside of the laboratory.

Chevron Services Company, a Division of Chevron USA, Inc.

At larger companies, a graduate degree in chemistry is often a requirement for a chemist to work in R&D. However, there are indications that this trend has changed in some areas as many companies have redirected a greater portion of their R&D to technical and customer service work. In this type of R&D problem solving, interpersonal and communications skills are often more important than a great depth and breadth of technical knowledge.

Most master's degree and Ph.D. chemists begin their industry careers by working in R&D as "bench" chemists. They may remain in the laboratory and progress up a series of positions on a "technical ladder." They may also become managers. Although most become R&D managers, some leave R&D to manage chemical plants

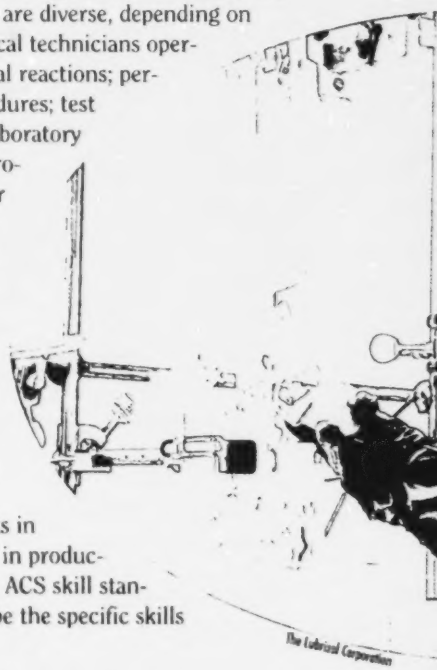
Vulcan Materials Company

or various businesses. As businesses have restructured and moved toward organizations emphasizing self-directed work teams, layers of management have been removed, and thus both employment and career advancement opportunities for managers have been reduced. Career development for managers now emphasizes lateral moves to broaden job skills and knowledge rather than promotion up a career ladder in a single, narrow business area.

Graduate degrees, particularly an M.B.A., are often required for business management and marketing positions. Some positions, such as information scientist, require an undergraduate chemistry degree with a minor in a particular field (in this case, information science), an advanced degree in information science, or extensive on-the-job training. For some fields, such as industrial hygiene, quality assurance, and regulatory work, there are fewer formal educational programs offered. On-the-job training is the way many people enter this specialty.

Chemical Technology

Opportunities for jobs as chemical technicians are available to those who obtain an associate's degree in applied science or chemical technology. Chemical technicians play a vital role in a variety of industries, working with chemists and chemical engineers to develop, test, and manufacture chemical products. Their career opportunities are diverse, depending on where they work, their education, skills, and experience. Chemical technicians operate standard laboratory equipment; set up apparatus for chemical reactions; perform chemical tests and experiments that involve various procedures; test for quality, performance, or composition; conduct a variety of laboratory procedures from routine process control to complex research projects; and help devise syntheses and analytical procedures. Other technicians act as troubleshooters; manage databases; monitor pollution levels by testing water, soil, and air; work in shipping to ensure that packaging of hazardous materials complies with regulations; and work in pilot plants, assisting engineers with running experiments in a miniature version of a manufacturing process. Chemical technicians work in laboratories making sure that processes are carried out safely, cost effectively, and according to the highest professional standards.



The Lubrizol Corporation

Technicians often gain unique critical skills that provide the competitive edge in today's business—a business world that demands high-quality results and efficiency. They are the experts in instrument operation, maintenance, and safety. They take pride in producing high-quality data, high-purity product, and effective results. ACS skill standards for chemical technicians have been developed that describe the specific skills and knowledge expected by employers.

Many chemical technicians take advantage of their employers' education assistance programs and earn bachelor's or advanced degrees. In the past, most chemical technicians were trained on the job. Today, industry demands a solid foundation in applied, basic chemistry and math, plus experience using various kinds of standard labware. The best preparation is a two-year associate degree program designed to prepare people for a career in chemical technology. Some companies hire chemists with a B.S. degree as technicians, but in many cases, employers say that the four-year degree is not necessary.

Ciba Specialty Chemicals, 1998

Chemical technology may appeal to those who have an interest in chemistry but do not want to spend four or more years getting a bachelor's or advanced degree; however, the education of a chemical technician does not stop upon entering the chemical industry. Continuing one's professional development is important because of the additional responsibilities technicians have today, and many opportunities for continued professional development exist. Many chemical technicians, as a result of the hands-on knowledge they have accumulated, decide to continue their formal education and obtain higher degrees and do so with support from their employers. Others advance by coupling their associate degree with other skills that industry deems valuable.

R&D Careers

Most chemists still work in the traditional career area of R&D. However, as many companies restructure, the nature of R&D is changing and R&D positions require an increasing number of skills. You may not work in the same area of chemistry in which you worked in college or graduate school. For instance, many polymer/plastics/materials chemists did not study polymer chemistry in college or even in graduate school. More work is being performed by self-directed work teams. Besides researchers and technical service specialists, these teams can include business managers, sales representatives, plant chemists and engineers, government regulations specialists, environmental chemists, and patent attorneys. Chemists have to learn to communicate effectively with these co-workers and work with them productively.[1]

Business today emphasizes reducing the length of R&D projects by simultaneously pursuing various activities that previously were done in sequence. For example, a team engaged in promising process development research to improve chemical product yields and purity may begin work on applications to develop markets and sales activities while additional process development and scale-up work is in progress and before the extensive research is

complete. By doing R&D this way, a company can reduce the time before they start making money from the fruits of their R&D. This approach requires coordination of work among the diverse team members and effective communication. When problems develop, the team must work together successfully to solve them. Many industrial chemists take communications and problem-solving skills courses to improve their ability to work productively on teams.

In addition, many industrial chemists spend a significant amount of their time communicating with customers, suppliers, and regulatory people and assisting sales and marketing efforts. This can include working on joint R&D teams with supplier or customer personnel, visiting prospective customers' labs or plants for discussions and to present seminars, giving papers at trade association conferences, preparing technical articles for trade association journals, and working in trade association activities such as serving as instructors for short courses. Sometimes they will help staff exhibit booths at trade shows. This list of activities emphasizes the importance of oral and written communications skills and interpersonal skills for chemists in R&D positions.

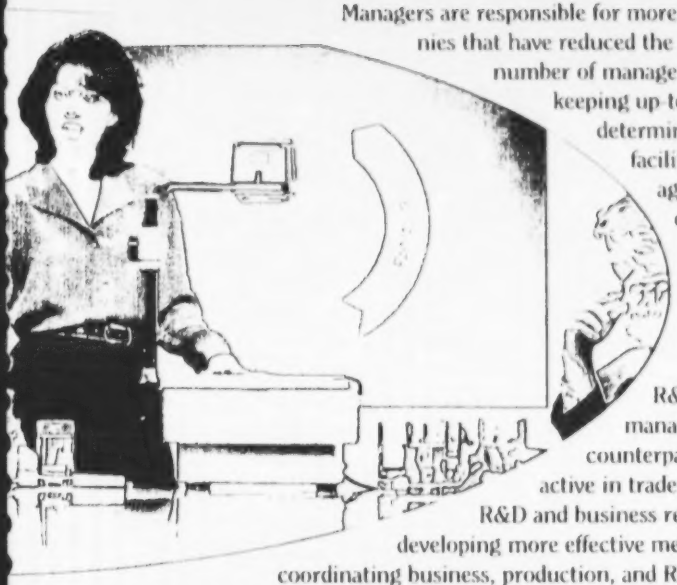
Even chemists who do not work with external customers must have good oral and written communications skills because they work with production personnel to develop new processes and improve current plant operations. These researchers work much more extensively with production personnel than was the case even a few years ago.

Cabot Specialty Chemicals, 1998

Chemists working on teams and having broader job responsibilities and less management supervision must be self-managing and have good time-management skills. Many firms fund time-management short courses and workshops for their employees because of the importance of this skill.

R&D Management

There are still many R&D management opportunities despite the trend to "flatten" the management structure. As specific projects and programs are managed by and conducted through self-directed work teams, R&D managers usually spend more time on strategic and resource issues. These include budgeting concerns and working with business and marketing managers to coordinate research programs with business goals. The traditional management activities of supplying project resources and setting R&D priorities are more important than ever.



Managers are responsible for more projects and more personnel in companies that have reduced the number of management layers and the number of managers in each layer. They must spend time keeping up-to-date on the status of various projects, determining and supplying resource needs, and facilitating R&D teams in other ways. As managers supervise larger groups, they must continue to spend substantial amounts of time on the traditional concerns of developing the capabilities of their current staff members and hiring qualified new personnel.

As more companies engage in joint R&D with customers and suppliers, R&D managers spend more time working with their counterparts to coordinate efforts. They are often active in trade associations and frequently participate in R&D and business restructuring programs. Restructuring and developing more effective methods of interacting with customers and coordinating business, production, and R&D efforts often require a substantial amount of a manager's time. Many business managers interact with government personnel and with patent agents and lawyers. Because most chemical companies are global, managers also interact with counterparts in many countries. In many companies, a route to advancement is service outside the United States.

Business Management and Marketing Careers

Some researchers move into business or plant management, business development, or business services such as purchasing. Business managers typically are experienced in sales, marketing, and sometimes in research or production. An advanced degree, usually an M.B.A., is often required, at least for new hires. Some manage businesses on a day-to-day basis; others are concerned with tactical issues such as current levels and trends of production, sales, costs, and profits. They often analyze technology trends and product needs to determine new areas of investment and research for their company. They also are concerned with longer-term strategic issues such as which businesses to enter and which to expand. They participate in decisions to commercialize new products, build new plants, and purchase or engage in strategic partnerships or mergers with other firms.

Business managers often serve as team leaders of previously described self-directed work teams. They usually lead by building consensus rather than simply issuing orders. Business managers often work through these teams to develop strategies to meet business growth goals.

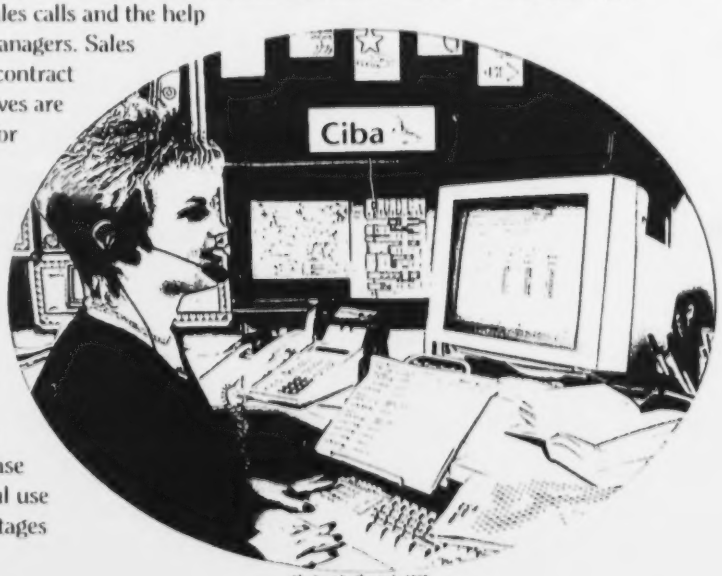
As noted earlier, a graduate degree—usually an M.B.A.— is required for most business management positions. Good communications and interpersonal skills are also essential in business management. Even after earning an M.B.A., many business managers take short courses to develop teamwork, time management, personnel management, and other skills. An advanced degree is usually not needed for plant management positions where technical skills are more important.

Marketing personnel often manage businesses on a day-to-day basis and make decisions on which markets to enter and which potential customers to pursue. They are often involved in the design of technical brochures and product advertisements. They collaborate with sales representatives to decide whether to participate in various trade shows and often staff exhibit booths at trade shows.

Marketers are similar to business managers. They talk to customers, work on project teams with R&D chemists and plant personnel, and sometimes make presentations at commercially oriented conferences and trade association meetings. Persuasive presentations and reports are necessary to convince top-level management to invest in various projects and ventures. Once again, good oral and written communication skills are essential for a successful career in chemistry.

Sales Careers

Sales jobs offer many opportunities for chemists with good interpersonal and organizational skills. Sales representatives call on existing accounts to solve and prevent problems in product deliveries and product quality. They often work with bench chemists to accomplish this. Sales representatives also call on prospective customers to persuade them to use their employer's products. This requires repeated sales calls and the help of researchers and business managers. Sales representatives participate in contract negotiations. The representatives are a critical information source for business managers and researchers. By working closely with customers, they identify the need for new or improved products. They often present technical seminars at customer facilities and trade association meetings. Frequently, these presentations are descriptions of product properties and field case histories illustrating successful use of the products and the advantages they provide.



Ciba Specialty Chemicals, 1998

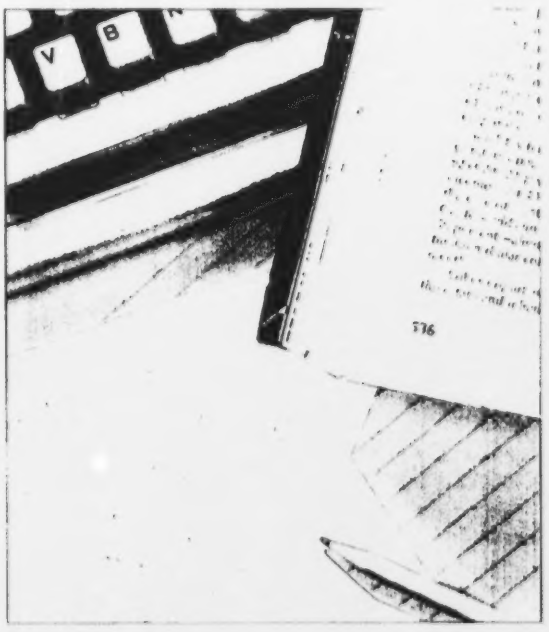
Bachelor's degree chemists can prepare for sales or marketing careers by taking business and marketing courses. They may be hired directly into these jobs. If so, they usually receive extensive training in their employer's technology and products. Training may be formal short courses with a lot of time spent with researchers, business and marketing personnel, and senior sales representatives, and possibly several months working in an R&D lab. New bachelor's-level hires may also receive extensive supervision and training from a sales group manager or team leader. A master's degree can be an advantage for technical sales when instrumentation experience is important for the position. Opportunities for sales personnel may include assignments outside the United States.

As sales personnel become more experienced and develop a successful track record, they are assigned more important and larger customers. They have the option of staying on the sales track and eventually handling a number of large corporate accounts, or they can move into marketing or business management.

Other Career Options

There are many other career options open to chemists. Among these options are information science, computational chemistry, business, government, law (including patent law), medicine, regulatory work, technical sales and marketing, technical service, and technology transfer, to mention a few.

Information science is a field that has expanded greatly with the advent of personal computers and online database searching. The ACS Division of Chemical Information focuses on this area. Information scientists must have sound technical knowledge and a good business sense. They research technical subjects for R&D chemists, plant personnel seeking solutions to operating problems, and patent lawyers interested in what work has already been done relating to specific technical developments that may be inventions. They also research business-related subjects such as discovering what production technology is used by their employer's competitors, production volume and pricing information, government regulations, and environment-related subjects. Information scientists use their training in chemistry to do abstracting and indexing at industrial companies and at organizations such as the ACS Chemical Abstracts Service.



ACS Technical Divisions

ACS divisions provide a medium that allows members with similar technical interests, regardless of geographical location or employment, to associate for the exchange of information in specific fields. This list of divisions gives an idea of some of the fields in which ACS members are employed.[2]

- ☐ Agricultural and Food Chemistry
- ■ Agrochemicals
- ☐ Analytical Chemistry
- ■ Biochemical Technology
- ☐ Biological Chemistry
- ■ Business Development and Management
- ☐ Carbohydrate Chemistry
- ■ Cellulose, Paper and Textile
- ☐ Chemical Education
- ■ Chemical Health and Safety
- ☐ Chemical Information
- ■ Chemical Technicians
- ☐ Chemical Toxicology
- ■ Chemistry and the Law
- ☐ Colloid and Surface Chemistry
- ■ Computers in Chemistry
- ☐ Environmental Chemistry
- ■ Fertilizer and Soil Chemistry
- ☐ Fluorine Chemistry
- ■ Fuel Chemistry
- ☐ Geochemistry
- ■ History of Chemistry
- ☐ Industrial and Engineering Chemistry
- ■ Inorganic Chemistry
- ☐ Medicinal Chemistry
- ■ Nuclear Chemistry and Technology
- ☐ Organic Chemistry
- ■ Petroleum Chemistry
- ☐ Physical Chemistry
- ■ Polymer Chemistry
- ☐ Polymeric Materials: Science and Engineering
- ■ Professional Relations
- ☐ Rubber Division, Inc.
- ■ Small Chemical Businesses

Business globalization means that information specialists must be able to locate technical and business information originally published in many different countries, in various languages, and in a host of different publications. Although most information scientists work for companies, many experienced information scientists are self-employed and contract for companies, particularly small and mid-sized operations.

Opportunities for chemists in writing and editing include working as technical writers producing plant operating instructions, product use instructions, technical catalogs, and product advertisements. These chemists usually work in marketing departments, although they sometimes work at R&D facilities. Some chemists are employed as writers in corporate public relations departments. Science journalism is another potential field for chemists with excellent writing skills. Although fewer science writers are employed by newspapers and wire services, writing for magazines for the general public and for the Internet continues to offer job opportunities. Some chemists edit research journals and work as technical writers and editors for trade magazines. Some science editors work for book publishers. Excellent technical knowledge and the ability to be a "quick study" are essential for science and technical editors. However, the most important skill is the ability to convey complex concepts in an interesting and accessible way by writing understandable, interesting, technically accurate articles for the general public as well as for technical specialists.

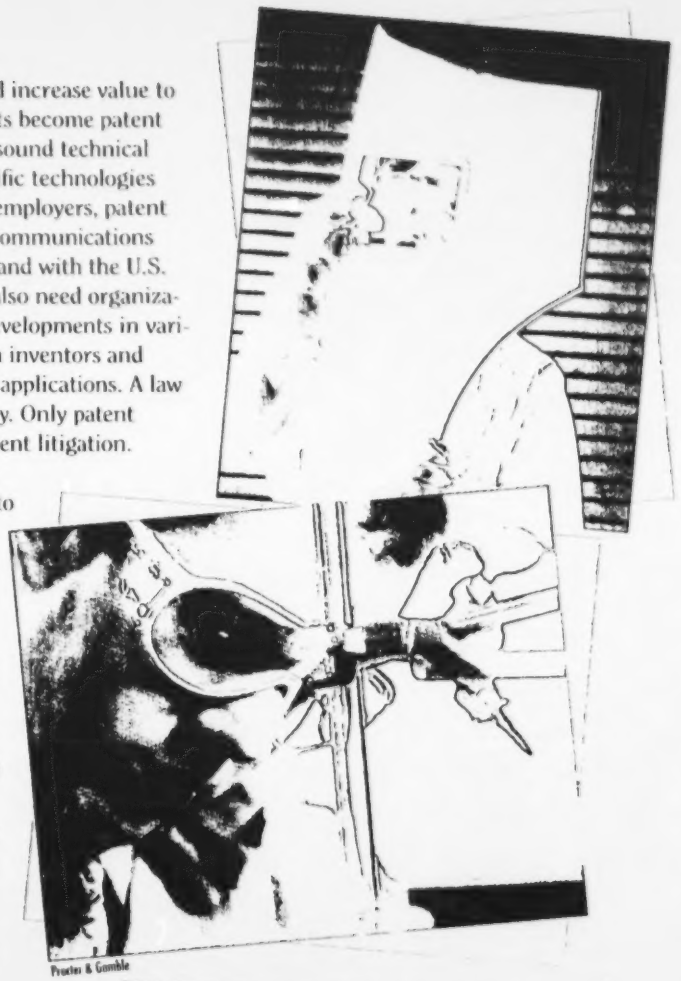
A minor in journalism and technical writing courses can provide students with the credentials they need to enter the science and technical writing field. Some chemists begin writing for their employers while still working as researchers or in other assignments. Sometimes these writing duties can become a full-time position.

Both bachelor's-level chemists and chemists with advanced degrees have found rewarding careers as patent attorneys or patent agents. Patent agents work with researchers to prepare patent applications. They collaborate with information scientists to determine how related technology impacts the prospects of obtaining a patent. They work with patent attorneys who often are their supervisors. Initial training to become a patent agent is relatively brief (two weeks or so) but intense. Continued

training is necessary to expand skills and increase value to the employer. Many experienced chemists become patent agents after working in R&D. Besides a sound technical knowledge and familiarity with the specific technologies extant and under development by their employers, patent agents and patent attorneys need good communications skills to communicate with researchers and with the U.S. Patent and Trademark personnel. They also need organizational skills to keep track of technical developments in various subjects. Patent attorneys work with inventors and information scientists to prepare patent applications. A law degree is required to be a patent attorney. Only patent attorneys are permitted to engage in patent litigation.

Computer applications pervade every field of chemistry, and all chemists need to be computer literate. Computer-related careers for chemists that go beyond basic computer literacy include computer modeling, process automation and control, software development and sales, and software evaluation and documentation as well as computer-aided experimental design (statistics). The ACS Division of Computers in Chemistry is devoted to these career areas.

Some chemists work in government regulations departments and chemical toxicology or health, safety, and environment departments. Others work as entrepreneurs developing and running their own companies. Some chemists become self-employed consultants later in their careers. Consultants include researchers, government regulations specialists, information scientists, and business and marketing managers with an excellent reputation in a particular business. Some chemists obtain M.D. degrees so that they can practice medicine or work for pharmaceutical companies, serving as liaisons between pharmaceutical researchers and medical doctors.



Procter & Gamble

Photo courtesy of Pfizer

Large and Small Companies

Researchers, managers, and sales, marketing, and production personnel are typically more specialized at larger firms. Larger firms often pay more. However, most new employment opportunities are at small and mid-sized companies. For instance, there are more than 1,300 small biotech companies that regularly hire chemists. Short-term

EMPLOYABILITY

In the past, most industrial chemists retired from the same company they started working for after completing their formal education. This secure situation has changed greatly as a result of corporate restructuring. We no longer speak of "permanent employment." Various surveys estimate that science professionals in industry will work in 10–12 positions for 3–8 employers. Companies may rely in part on contract or temporary personnel who can be discharged with a minimum of disruption upon completion of a project. Many employers will discharge chemists more readily now than in the past.

Chemists today are more concerned with "employability" than with "employment." Employability requires career-long learning, self-management of career, constant skill improvement, renewing and reinventing professional capabilities, and, very importantly, developing "portable" competencies. Examples of such competencies are

- ☐ the ability to communicate (not only with peers but also with scientists from other disciplines as well as with nontechnical people),
- ☐ leadership skills,
- ☐ problem-solving ability,
- ☐ flexibility,
- ☐ creativity,
- ☐ teamwork skills,
- ☐ initiative/follow-through,
- ☐ interpersonal skills,
- ☐ computer literacy, and
- ☐ business orientation.

These competencies are valued skills that you carry with you to your next employment.

In addition, as companies reengineer and restructure, their technology needs change. As a result, some chemists are finding that their employers no longer need their specialty. This can happen even if the employer is hiring chemists in other fields. In this situation, chemists must be able to convince employers, usually by their past accomplishments, that they can switch fields and work productively in a new area. Alternatively, they may obtain a new job in a different field as they perceive a declining demand for chemists in their specialty. For example, some petroleum chemists and engineers now work in enhanced oil recovery instead of in an oil refinery. As demand for petroleum specialists decreased, many of the more adaptable and energetic chemists and engineers found new careers in soil remediation and hazardous-waste-site cleanup that drew on their knowledge of petroleum technology and the behavior of fluids in permeable media (rock or dirt).

Chemists need not become discouraged if they have to change fields. Ronald Breslow, ACS Past-President, has observed, "Successful people understand that they have to keep learning all the time. The best people are not working on the same topics on which they did their Ph.D.s." Chemists are better prepared than most to make career transitions in or out of chemistry.

Solutia, Inc

career advancement opportunities are often better at small companies that are growing more rapidly than large firms. Long-term career growth and advancement opportunities are often better at larger companies, although competition for promotions and choice assignments can be fierce.

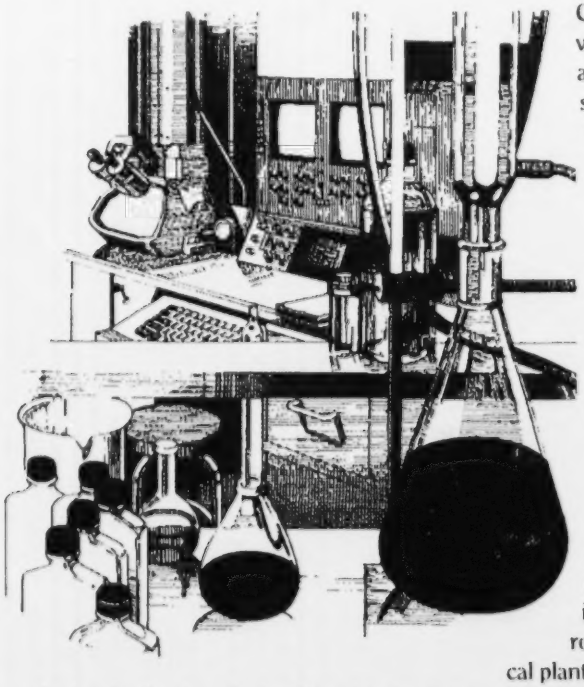
Industrial chemists work in companies ranging in size from huge multinational corporations to small entrepreneurial firms. In a recent survey by the ACS, it was found that 60% of recent bachelor's graduates who went directly into the workforce after graduation took jobs in industry, and the rest found jobs in schools and universities, hospitals, and government. About half of the new jobs in industry were in smaller companies—those with 500 or fewer employees; about 15% were in companies employing more than 25,000; and the remaining 35% were in medium-sized companies.

Workplace Trends

Corporate reengineering, globalization, employee empowerment, and other trends are changing the workplace culture for many chemists. With fewer managers, staff chemists work under less hierarchical supervision. At the same time, chemists are more dependent on their co-workers as they increasingly work on teams. These teams often include business managers, sales representatives, technicians, patent attorneys, industrial hygienists, government regulations specialists, and others. The goal of these teams is to reduce the time it takes to develop new and improved products and chemical processes.

Career Stages in Industry

The career stages of a professional industrial chemist have become less distinct as a result of corporate restructuring and the elimination of layers of management. Career progression no longer means ascending a career ladder in one narrow business or technology area. Chemists are more likely to work in a variety of businesses and technology areas and experience a series of lateral shifts rather than a clear advancement up a promotion ladder. This is true whether one works in R&D, business operations, or business planning.



The career stages of an R&D chemist in industry tend to be entry-level, experienced professional handling increasing responsibilities, to experienced professional with solid experience in multiple technology areas, to inside consultant. The entry-level chemist is the recent hire who is learning new technology and productive work habits such as time management, teamwork, and management of technicians and research projects. The experienced professional works with increasing independence, plays a leading role on teams, and often works with chemical plant or customer personnel. Experienced professionals often transfer to different technology areas that provide opportunities to learn new fields of chemistry and work with different people.

Many competent chemists opt to make the transition to inside consultant. These individuals may have their own research projects; however, their expertise is also recognized and valued by co-workers in other technology areas. The inside consultant spends a substantial amount of time advising co-workers on their projects and often serves on several project teams. Internal consultants have a lot of credibility with senior managers in research and in business areas, and thus their opinions have a great deal of weight.

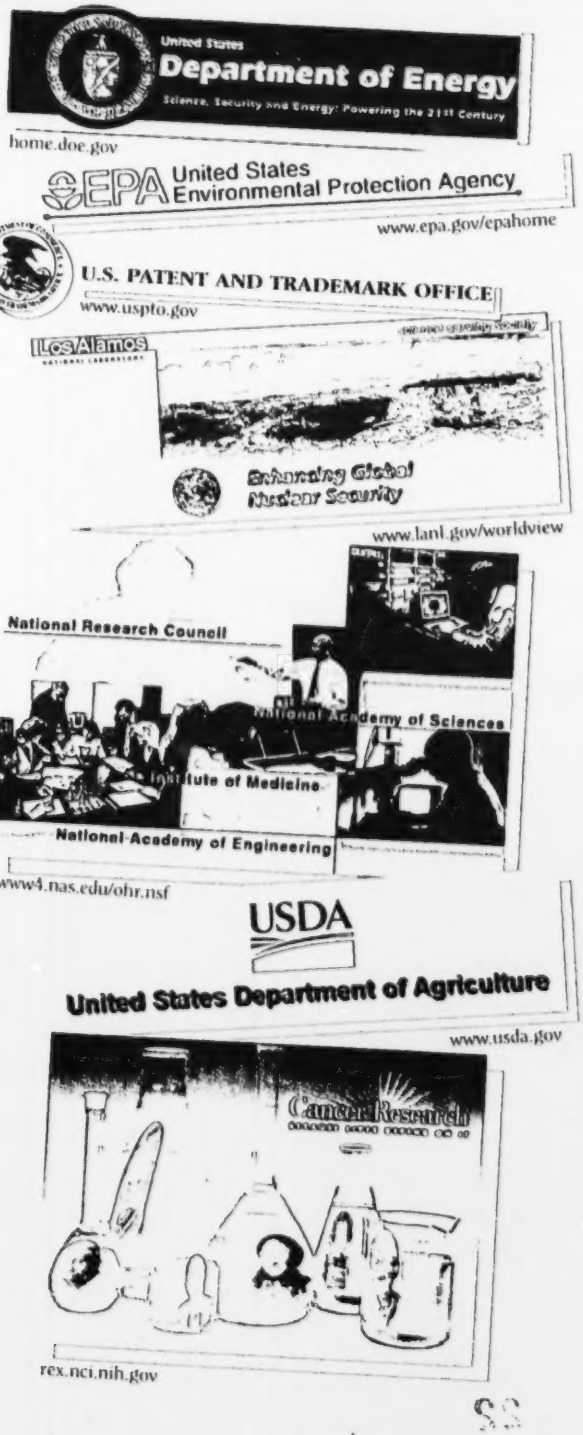
Many global chemical companies have laboratories outside the United States; one route for advancement of experienced professionals or managers is service in one of these overseas laboratories.

Usually people enter R&D management at the experienced professional stage of their R&D careers. Today, there are few positions above first-line research manager in restructured companies. Managers can stay in place, capitalize on the few promotion openings that occur, or move laterally from one management slot to another in a different technology area. They can also transfer to business strategy, business management, or plant management positions. Today this is often the path followed by people in high-level research management positions. Working in various company operations besides research gives them the perspective they need to coordinate R&D with company business goals.

Working in business operations and strategy, chemists can hold a series of staff positions that broaden their experience without necessarily moving up the career ladder. Although many people may have the word "manager" in their title, they often manage or coordinate business operations without actually having people report to them. Experienced staff members compete for the few "people manager" positions in reengineered companies. Some of these managers transfer to plant management positions to expand their expertise and position themselves for promotion to higher levels of management. One of the highest levels of management, one which few people achieve, is being manager of a large business unit or senior manager (vice president or above) of a large company. In smaller companies, people with substantial amounts of experience more frequently reach this senior level.

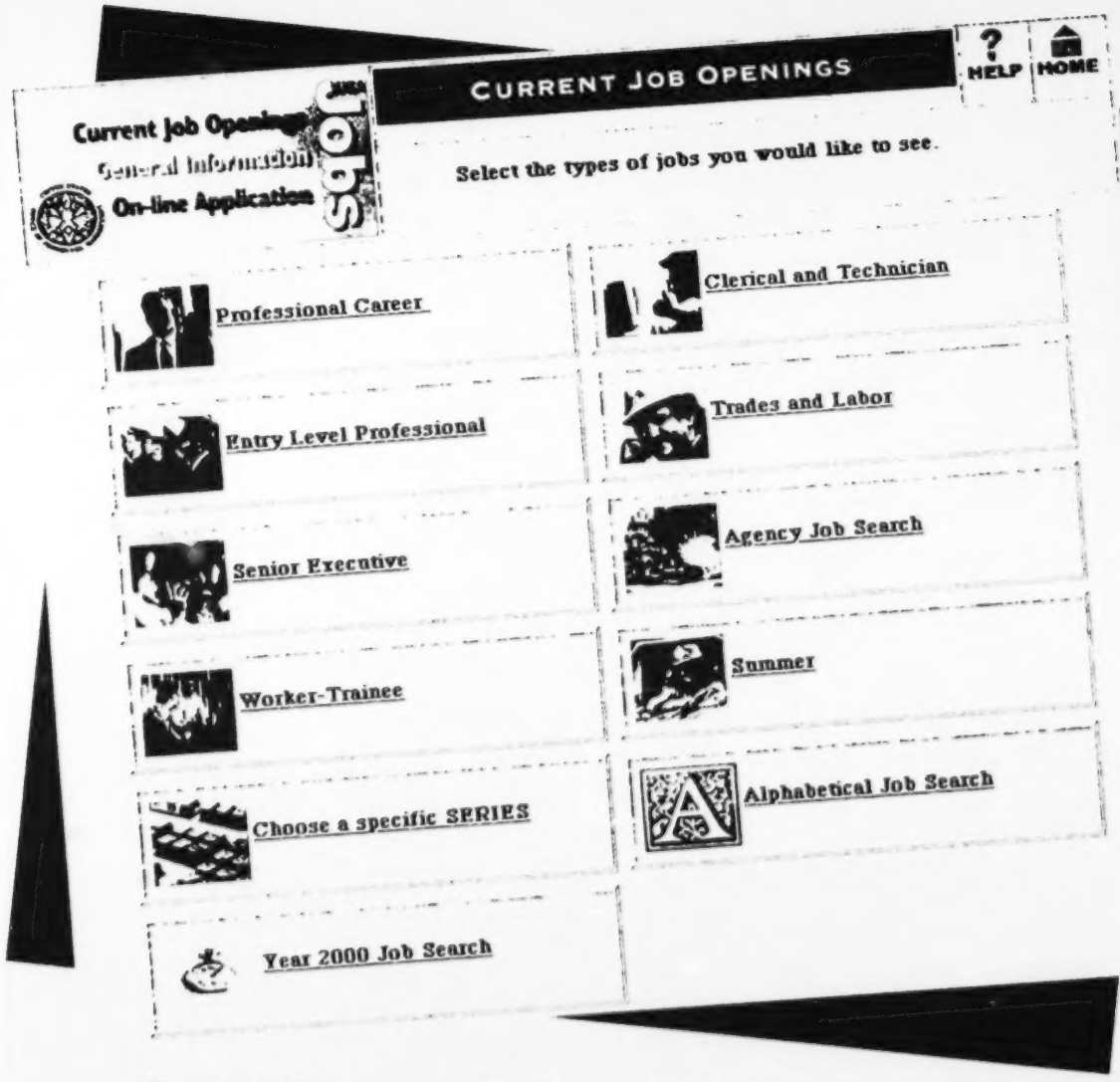
In chemical plants, the entry-level chemist may look forward to becoming manager of a production unit and eventually the entire plant. However, most of these managers are chemical engineers. Chemists who attain these positions usually hold various positions in R&D and business operations before working in a plant. Plant managers often become managers of company business units. From these posts, they compete for promotion to senior management.

3 CHEMISTRY CAREERS IN GOVERNMENT



Federal, state, and local government units employ many chemists. Chemists are the largest group of scientists working for the federal government. About 10% of all chemists are employed by the government.

Many work for large research laboratories such as the National Institutes of Health (NIH) and the Naval Research Laboratory. Other major employers of chemists in the federal government include the Food and Drug Administration (FDA), Environmental Protection Agency (EPA), Department of Agriculture (DOA), Department of Justice (DOJ), the National Institute of Standards and Technology (NIST), the Occupational Safety and Health Administration (OSHA), and the Patent and Trademark Office (PTO). Other federal areas that employ chemists are the Departments of Energy (DOE), Defense, Interior, Commerce, Health and Human Services, and State, and agencies such as the Central Intelligence Agency and the Centers for Disease Control and Prevention. Chemists in federal government may do basic or applied research. Much of this work is aimed at developing the scientific basis for government regulations (e.g., EPA). Chemists also perform testing work needed to enforce government regulations and monitor their effectiveness (e.g., NIST). Chemists are responsible for administering government funding to universities and research institutes (e.g., DOE). Other chemists work as program administrators within the government and as writers and editors



The U.S. Office of Personnel Management Web site (www.usajobs.opm.gov) offers a wealth of information for those seeking government jobs.

of government regulations and other documents (e.g., OSHA). Some are employed by the State Department as technical experts and as technical attachés in embassies in foreign countries.

Most of the thousands of scientists working at NIH do so at a very large research center near Washington, DC. There chemists, biochemists, oncologists, and scientists from other fields investigate the cause of various diseases to understand how they might be treated or cured. Chemists at the FDA are located in laboratories across the country to enforce federal standards for foods, drugs, and cosmetics. The DOA has four Regional Laboratories employing chemists who study ways to better utilize agricultural products.

How To Get a Job in Government

Applicants need a civil service rating to apply for a federal government job. This rating is based on level of education and experience. Obtaining a civil service rating is a time-consuming process, so you should apply as much as nine months before you enter the job market. To do so, telephone (800) 555-1212 to obtain the phone number and address of the nearest Federal Job Information Center. You can also write to the Office of Personnel Management, Washington, DC 20415, for a physical sciences application. Both your area Federal Job Information Center and the Office of Personnel Management can provide the specialized application forms you will need to apply for government positions.

The Federal Research Report reviews available positions, their locations, and applications procedures. You can subscribe to this bimonthly report by calling (703) 281-0200 or writing the Federal Research Service, Inc., P.O. Box 1059-AC, Vienna, VA 22180. The U.S. government's Office of Personnel Management (OPM) also posts current job openings on a Web site, www.usajobs.opm.gov. This is the federal government's official site for jobs and employment information. Selecting "Current Job Openings" from the home page menu will lead you to another menu of choices that includes the category "Entry Level Professional" as well as other options.

Photo courtesy of Eugene Mopsik

Developing a contact within a specific agency or laboratory where you want to work can be very helpful. You may be able to do this at ACS local section meetings if there are federal facilities in your area. You may also be able to meet these individuals at regional or national ACS meetings.[3]

In addition to the federal government, there are many employment opportunities for chemists in state and local governments. Some chemists work as forensic chemists for state or municipal law enforcement units. Forensic chemistry requires a broad background in chemistry, a specialization such as analytical chemistry, computer science, document analysis and handling, and/or familiarity with laws and government regulations and how to interpret them. Other chemists work in municipal and county hospitals. Municipal fire departments are hiring chemists to work in hazardous materials response units. Many state governments operate their own environmental protection agencies that employ chemists. States and some cities have consumer protection agencies that employ chemists. To learn more about these opportunities, contact your state employment commission and city employment offices.

In government, there are basically two career tracks: research and management. In research, chemists can look forward to promotions that change job titles but often mean little change in responsibilities. Eventually they may become first-line research managers. These jobs usually include both research project responsibilities and people management responsibilities. From this position, one can aspire to higher level management positions in which one becomes a full-time manager of research divisions or an entire research center. Compared with industry, fewer transfers occur from one facility to another; however, some chemists do transfer from one agency to another.

For example, some petroleum chemists and engineers now work in enhanced oil recovery instead of in an oil refinery. As demand for petroleum specialists decreased, many of the more adaptable and energetic chemists and engineers found new careers in soil remediation and hazardous-waste-site cleanup that drew on their knowledge of petroleum technology and the behavior of fluids in permeable media (rock or dirt).

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Dr. Virginia Maxwell, a physical chemist, works as a criminalist with the Connecticut State Police Forensic Laboratory.

Dr. Maxwell examines clothing obtained from a crime scene.

Chemists work as industrial hygienists at OSHA and the National Institute for Occupational Safety and Health. Chemists, usually analytical chemists, work as forensic scientists in the crime labs of the DOJ's Federal Bureau of Investigation (FBI). At the PTO, chemists work as patent examiners, and they receive special training. Some continue in this field and move to supervisory positions. Others go to law school at night and become patent attorneys. After obtaining law degrees, they may continue to work at the Patent and Trademark Office, work for industry, or go into private practice.

Government salaries, particularly starting salaries, often are lower than in private industry. However, the gap has narrowed in recent years. Despite government cutbacks, jobs remain more secure in government than in private industry, and fringe benefits are excellent.

CHEMISTRY CAREERS IN EDUCATION

Education includes elementary, middle, and high schools, two-year colleges, four-year colleges, and universities. Teaching in elementary, middle, and high schools and in some two-year colleges often involves teaching other sciences besides chemistry.

Thinking back on your own precollege education, you'll realize that, in addition to teaching a subject such as science, teachers also counsel and guide students. They prepare examinations, develop curricula, meet with and advise parents, and work with other teachers and administrators to keep the school running smoothly. To fulfill these responsibilities, states require teacher certification.

Primary and Secondary School Teaching

To teach in public schools, you must take the necessary education courses to obtain a teaching certificate in addition to courses in your major discipline. Due to a shortage of science teachers, some school districts are hiring B.S. or B.A. chemists to teach, provided they take the necessary courses required to obtain a teaching certificate. These courses can usually be taken in the evening, on weekends, or in the summers. Each state's department of education specifies the courses needed for certification and whether certification can be waived because of a shortage of certified teachers. These requirements are uniform for all the school districts in a given state; however, the courses required vary from state to state. Contact your local school district to find out what courses you would need to complete to be certified as a teacher in your state. If you plan to move after graduation, determine the certification requirements in your new state. Many private/parochial schools do not require a teaching certificate; however, many of them offer salaries less than public schools.

Often chemistry teachers in secondary (high) schools also teach mathematics or other science courses such as physics or biology. It is for secondary school science teachers that school districts are most

willing to waive teaching certification requirements until they can obtain certification. Secondary school teachers often enjoy the satisfaction of having students choose careers in science and engineering as a result of their experiences in their science courses.

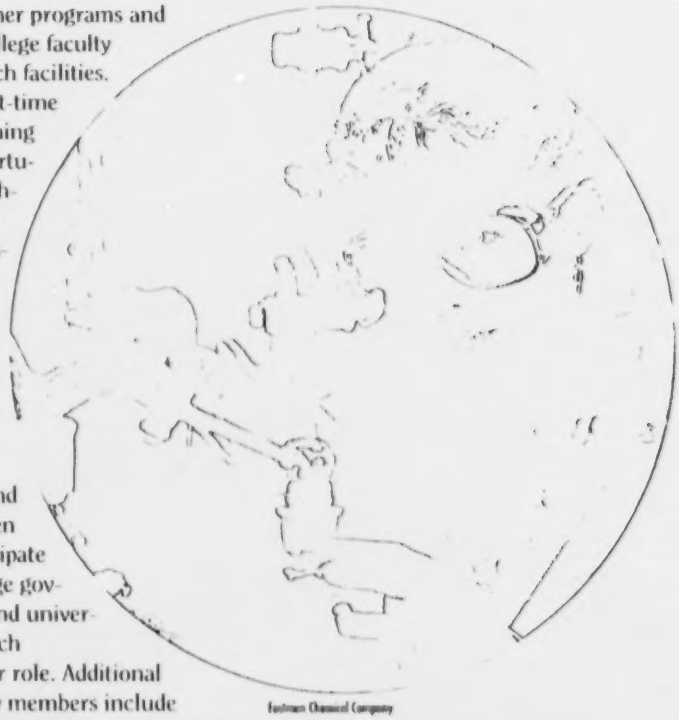
After you begin your teaching career, you will find that additional courses, often culminating in a master's degree, will improve your knowledge of chemistry and your teaching skills. An advanced degree also will improve your salary, promotion prospects, job security, and marketability. This is particularly true for secondary school teachers. Depending on your career goals, the courses you take may be primarily chemistry courses or education courses. You may also find it advantageous to broaden your skills beyond that of science by taking the courses necessary to become certified in other fields, particularly administration.

Two-Year College Teaching

At two-year colleges, the primary emphasis is on teaching, not research. Many who prefer teaching to supervising research find teaching at two-year colleges more rewarding. These faculty members often teach more courses than their counterparts at research universities. Faculty members may hold either M.S. or Ph.D. degrees. The fraction of faculty members holding Ph.D. degrees is increasing as the academic job market becomes ever more competitive. Tenure is offered at most but not all two-year colleges. Normally tenure is awarded after two to five years of probationary employment. Although any research the faculty member accomplishes will be a positive factor in tenure evaluations, the primary emphasis is on teaching. Usually, the facilities for doing bench research are very limited in two-year colleges. However,

National Science Foundation summer programs and other opportunities exist to give college faculty members access to first-rate research facilities.

Many two-year colleges offer part-time positions, which often involve teaching evening classes. This provides opportunities for chemists to combine teaching with another job, education, or personal commitments such as raising a family.

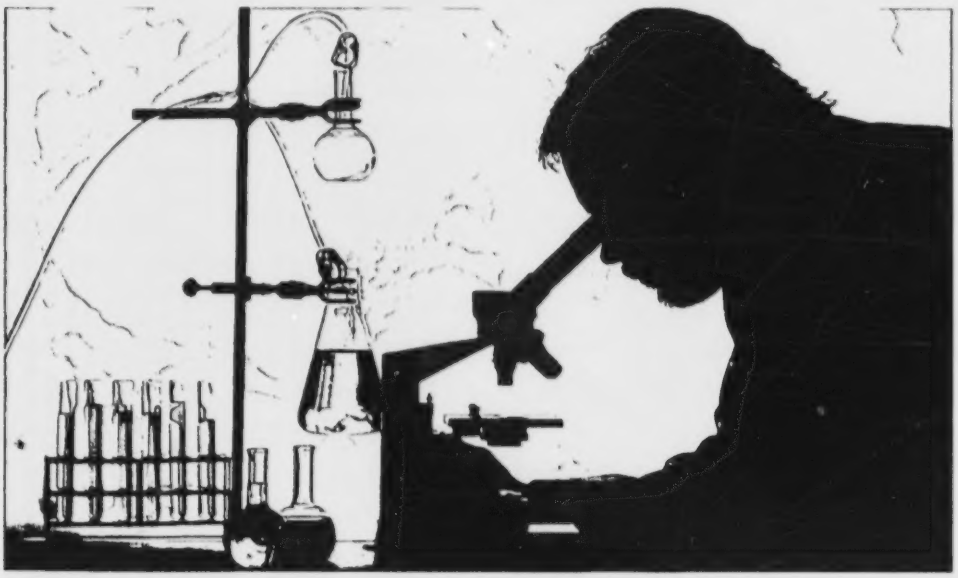


Eastman Chemical Company

Four-Year College and University Teaching

Chemistry faculty members at four-year colleges and universities teach chemistry courses, prepare and grade exams, counsel students (often providing career advice), and participate in chemistry department and college governance. At four-year institutions and universities with graduate schools (research universities), research plays a major role. Additional responsibilities of chemistry faculty members include designing and executing a creative research program. To do this, the faculty members must obtain research funding by writing grant proposals, persuade students to work with them as bench researchers, and supervise and guide these students in their research while allowing them sufficient independence to develop as creative chemists in their own right.

To compete for positions at research universities and some four-year institutions, a Ph.D. is usually required. Participation in programs specifically designed to prepare future faculty, such as those sponsored by ACS and focused on emerging instructional techniques compatible with learning theory, gives the aspiring faculty member a "leg up." In addition, most candidates need



to have successfully completed a postdoctoral research appointment. Successful completion is indicated by research publications and an outstanding recommendation from the professor. A postdoctoral position is also helpful for applicants for chemistry faculty positions at four-year institutions.

At many four-year and two-year colleges, opportunities to perform chemical research are limited. Consequently, there is less emphasis on postdoctoral research experience at these institutions. What is valuable in competing for these jobs is experience in chemistry teaching, including temporary college teaching positions.

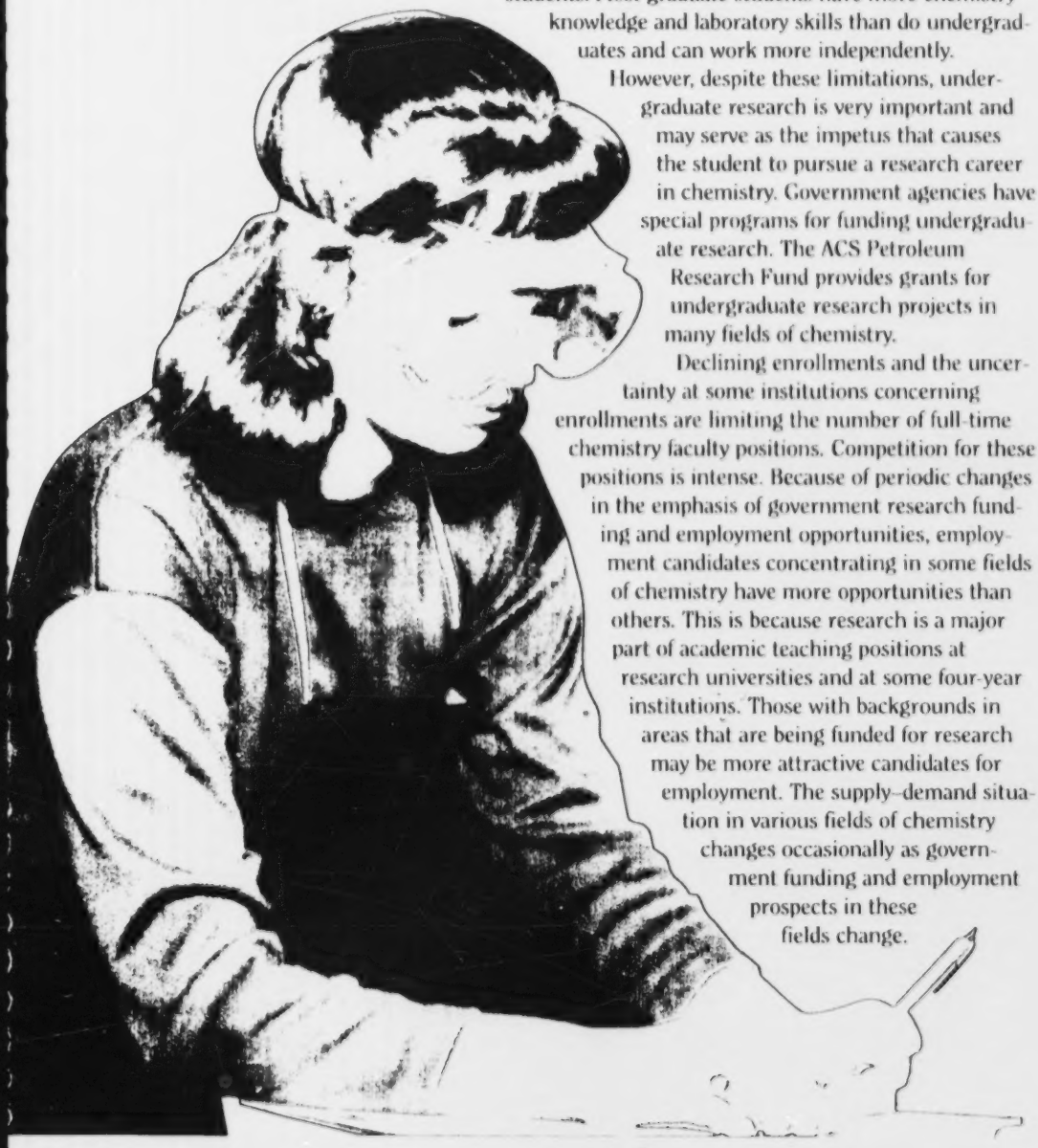
Writing successful grant proposals is critical to career success for faculty members at research universities and some four-year institutions. Successful graduate school and postdoctoral research is helpful as is previous independent research.

Research success is usually measured by both the number and quality of publications in chemistry journals. However, the ability to organize your thoughts and write clearly and well are also key to preparing successful grant proposals. The ability to present oral research papers at conferences (such as ACS national and regional meetings) and seminars at other universities is also important in developing a solid professional reputation that may influence grant proposal reviewers in your favor.

Research funding obtained for creative projects and publication of interesting results in chemistry journals are necessary for career success at research universities. Research success and publishing of results are the major factors in deciding whether to award an assistant professor tenure. Without tenure, chemistry department faculty members are employed under a series of one- to six-year contracts. At one or more times during an assistant professor's first six years at a research university, he or she will be considered for tenure. Assistant professors who do not obtain tenure are given a seventh year to obtain another position. Some people in this position, particularly those who are outstanding teachers, obtain positions at four-year institutions or two-year colleges. Others enter industry or obtain non-faculty staff positions.

Research university faculty life can be demanding but very rewarding, particularly after gaining tenure. Writing grant proposals will take substantial amounts of time at all stages of your career. However, as you develop a scientific reputation through your accomplishments and develop expertise in writing persuasive grant proposals, obtaining research funding will become somewhat easier. Sabbatical year leaves at other institutions, visiting lectureships, writing research monographs or textbooks, and industrial consulting can provide variety in your work and opportunities for accomplishment. Consulting fees and patent royalties can increase your income.

Faculty members at four-year colleges can obtain funding from the National Science Foundation and other sources to spend summers doing research at universities if their institution lacks adequate research facilities. They can also compete for research grants, often in special categories designed for undergraduate research programs. Undergraduates have much less time and often less interest in working with faculty members on research projects than do graduate students. Most graduate students have more chemistry knowledge and laboratory skills than do undergraduates and can work more independently.



However, despite these limitations, undergraduate research is very important and may serve as the impetus that causes the student to pursue a research career in chemistry. Government agencies have special programs for funding undergraduate research. The ACS Petroleum Research Fund provides grants for undergraduate research projects in many fields of chemistry.

Declining enrollments and the uncertainty at some institutions concerning enrollments are limiting the number of full-time chemistry faculty positions. Competition for these positions is intense. Because of periodic changes in the emphasis of government research funding and employment opportunities, employment candidates concentrating in some fields of chemistry have more opportunities than others. This is because research is a major part of academic teaching positions at research universities and at some four-year institutions. Those with backgrounds in areas that are being funded for research may be more attractive candidates for employment. The supply–demand situation in various fields of chemistry changes occasionally as government funding and employment prospects in these fields change.

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The most common career starting point remains the position of the tenure-track assistant professor, although the likelihood is greater than in the past that a candidate might start in a temporary, non-tenure-track position. Assistant professors at research universities face the responsibilities of recruiting research students and obtaining research funding, accomplishing solid research in their first three to four years at the institution, and publishing the results as scientific papers in respected research journals. They also have to fulfill their teaching responsibilities. If they do this, they can receive tenure and move on to the next stage of their career, first as an associate professor and then as a full professor. They must establish a solid track record of research accomplishment, successfully applying for grants to fund their research and training Ph.D.s whose professional accomplishments reflect favorably upon them. They may change research areas as research funding shifts from one field to another. They may use their expertise to earn extra money by consulting for industry. Eventually, their accomplishments may be recognized by local and national scientific awards.

EDUCATIONAL PREPARATION FOR CAREERS IN CHEMISTRY

Your college education is the first step toward your future chemistry career. Because chemistry offers so many different career opportunities, it can be your entrée into a whole spectrum of careers—scientific and nonscientific. By the end of your sophomore year, you should begin to consider your career options, choose as your goals one or two fields that interest you most, and plan the rest of your education with your goals in mind. When you are searching for your first job, regardless of the career path you choose, your college grades and the courses you choose will be critical. They offer vital proof of your mastery of basic principles and how well you prepared for specific career options. Your formal education becomes less important (and your on-the-job training and accomplishments more important) later in your career. For you, the graduate, education is the primary factor in deciding whether you will be hired for a specific job. Today the chemical industry has become global; therefore, you may want to include the study of a foreign language if you are considering going into industry.

Extracurricular activities can be very important. Participation in extracurricular activities can be used to demonstrate teamwork skills as well as leadership skills. Participation in ACS Student Affiliate activities lets chemistry faculty members know you and your capabilities better and allows them to write better letters of recommendation for you. Employers look for interpersonal, leadership, and communications skills, so anything you can do to demonstrate that you possess these skills will make you a more attractive candidate for employment.

The variety of degrees in chemistry and related fields include

- The Associate Degree, Associate in Science Degree in Chemistry, or Associate in Applied Science Degree (A.A.S.) degree in Chemical Technology. Many chemical technicians begin their careers by earning this degree. Afterward, some graduates continue their studies to earn a bachelor's degree in chemistry or a related field.
- The Bachelor of Science (B.S.) or Bachelor of Arts (B.A.) degree in chemistry. The designation of these four-year B.A. or B.S. degrees varies from one institution to another. When a college offers both degrees, the B.S. degree typically includes more chemistry, other science, and mathematics courses and is usually recommended for students who

Postdoctoral Research

Most research universities, some colleges, and most pharmaceutical companies prefer that candidates for employment also complete some postdoctoral research in addition to earning the Ph.D. degree. In a postdoctoral research position or "postdoc," Ph.D. chemists work with a professor on a research project but do so more independently than they did as graduate students. Usually they leave the institution where they earned the Ph.D. degree to work in another university or in some cases a government or industrial laboratory. In addition to postdoctoral research undertaken to prepare for an academic career, postdocs are becoming increasingly common before beginning a research career in industry, particularly the pharmaceutical industry. Postdoctoral positions typically last one to three years. They offer chemists two possibilities. The first is to work in the same field as they did when earning their Ph.D. This provides a depth of knowledge and specialization that can be very useful if there are plentiful job opportunities in their field of specialization. The second is to work in a field different from the one in which they earned their Ph.D. This will let them broaden their knowledge and experience, thus qualifying them for a broader range of job opportunities and demonstrating their versatility to employers. A postdoc demonstrates mastery of a field within chemistry and independence in performing research.

plan to attend graduate school, whose goal is a research career, or who wish to pursue a generalized chemistry degree. The B.A. degree typically includes more elective courses outside of science, engineering, and math, and is often recommended for students wishing to pursue business-oriented careers in sales, marketing, or management. These students should use their electives for well-designed courses of study in appropriate subjects such as marketing, business management, economics, and languages. For those who wish to pursue a career in research, an advanced degree is almost essential. The B.S. degree in chemistry is an excellent route to an M.D., law, or business degree. The ACS Office of Professional Training maintains an online list of schools offering ACS-Approved curricula leading to a bachelor's degree (www.acs.org/cpt/hp.htm). Chemists with a B.S. degree in an ACS-approved curriculum generally fare better than those with a degree from a nonapproved curriculum. At some industrial companies, it makes a difference in the level at which you may be hired.

- ☐ The Master of Science (M.S.) and the Master of Arts (M.A.) degrees in chemistry and related fields. The M.S. and M.A. degrees are typically earned after two years of study after the bachelor's degree. Earning a bachelor's degree in chemistry and a master's degree in a related field (or vice versa) can be very useful to students planning an interdisciplinary career. A master's degree can also serve to deepen or broaden your chemistry knowledge and better prepare you for an industrial career. Some students use the master's degree to help them determine their career interests and aptitudes before making the longer commitment to a Doctor of Philosophy (Ph.D.) chemistry program. This approach can be particularly useful to students who were not able to participate in an undergraduate research program. For them, the master's degree is their first real exposure to chemical research. When the M.S. degree is the terminal degree, a research thesis may be required. An M.S. degree program with a specific focus (such as an M.S. in analytical chemistry) or one with a thesis is more valuable than a general degree program that requires coursework only.

- ☐ The Doctor of Philosophy (Ph.D.) degree in chemistry. The Ph.D. degree is preferred for many research positions in industry and government. Colleges and universities usually require Ph.D. chemists when they hire new faculty members. Earning a Ph.D. degree demonstrates a long-term commitment to chemistry as a career. It provides the chemist with a depth of chemical information and the ability to do productive research. Obtaining a Ph.D. degree usually takes four to six years after the bachelor's degree. Depending on the graduate school attended, an M.S. degree may not be necessary to obtain the Ph.D. degree.

- The Doctor of Arts (D.A.) degree and Doctor of Chemistry (D. Chem.) degree. The D.A. degree is designed for chemists wanting to teach in four-year colleges. The D. Chem. degree is tailored for chemists wanting to work in industry and includes one or more periods of one to four months in which the student works in an industrial research laboratory. Although this degree goes by a variety of names, some schools have been changing its designation to Ph.D.

Deciding Whether To Attend Graduate School

How much education is enough? The answer to this question depends on your interests, abilities, and career goals. The primary role of a bachelor's degree chemist in R&D is support while that of the Ph.D. chemist is supervision. Although not excluded from research management, bachelor's or master's degree chemists typically find it more difficult to attain a research management position.

Before deciding whether to apply to graduate school, determine the kind of career you want. Consider your interests and abilities and your lifestyle and family goals when making this determination. One of the reasons so many chemists enjoy their careers is that their careers are a good match for their interests and abilities. Graduate school is usually the best option for those who want to spend a major portion of their career doing R&D work. However, be prepared to revise your plans as your interests change. For example, after working in research, some industrial chemists develop an interest in technical management—guiding research and determining what research areas are explored at their companies. They may opt to move from a research track to a management track.

In deciding whether to continue your education past the bachelor's degree, assess your abilities as objectively as possible. Consult your faculty advisor and other faculty members, graduate students, and some chemists who have completed graduate school. Even if they do not know you well, they can still

Delaying Graduate School

Delaying graduate school can provide time for chemists to choose a specialty. For example, industrial chemist John Borchardt really enjoyed his undergraduate research project at the Illinois Institute of Technology. He notes, "I became far more enthusiastic about chemistry as a result of this experience. The encouragement of my undergraduate research advisor was a great motivator. However, I still was not sure I was ready for the rigors of graduate school. I earned an Illinois high school science teaching certificate after receiving my B.S. degree in chemistry and taught high school chemistry for a semester while considering career options. While I enjoyed teaching, the experience made me realize that my primary interest was research. So I decided to attend chemistry graduate school at the University of Rochester. The added maturity I gained as a result of my high school teaching experience helped me survive and succeed in graduate school."

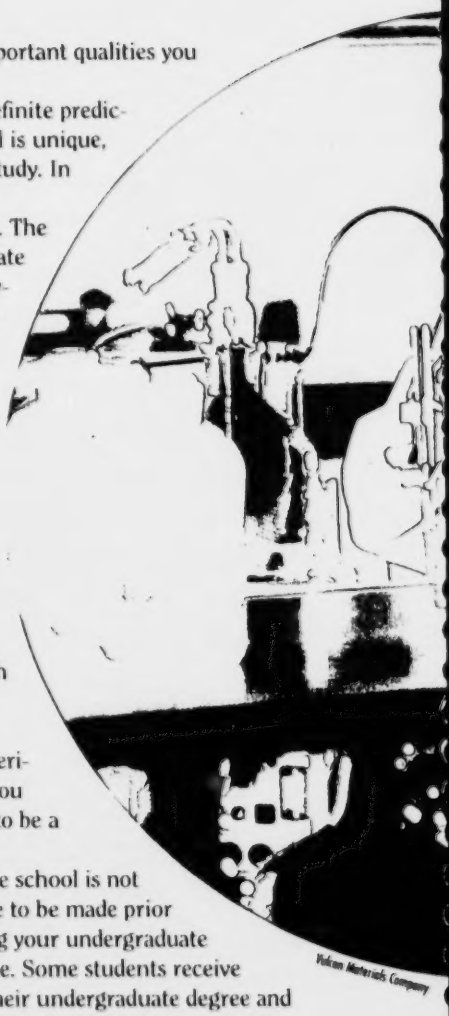
Benefits of Co-ops and Internships

Co-op/internship students benefit from the experiences in the workplace because they

- ☐ gain technical knowledge through use of state-of-the-art equipment,
- ☐ acquire new or advanced skills,
- ☐ integrate classroom theory with workplace practice, thereby obtaining a better understanding of what is learned in theory,
- ☐ learn how to apply what they know to real-world problems,
- ☐ enhance confidence and commitment in the chosen field of study,
- ☐ improve understanding of workplace culture and competencies,
- ☐ explore career goals and options before graduation,
- ☐ cultivate after-graduation employment opportunities,
- ☐ network with current professionals,
- ☐ evaluate personal strengths and weaknesses,
- ☐ sharpen interpersonal skills,
- ☐ gain maturity and lifelong learning skills, and
- ☐ earn while they learn.

advise you on what they think are the most important qualities you need to do well in graduate school.

Success in undergraduate studies is not a definite predictor of graduate school success. Graduate school is unique, far more than an extension of undergraduate study. In short, graduate school requires more work, a stronger commitment, and concentrated effort. The coursework is harder and more intense. Graduate school requires creativity in research and analysis—much more than required of undergraduate students. To succeed at research, you will have to be self-motivated and work independently, which require maturity and drive. A major component of many master's and nearly all Ph.D. degree programs is writing a thesis. Writing a thesis is a major effort that demonstrates research accomplishments and also indicates whether you can organize and effectively communicate complicated technical information to others.



Vulcan Materials Company

Working on an undergraduate research project will help you decide if you find research rewarding and thus would enjoy graduate school. Working in an industrial research lab after graduation or as part of an industrial experience program will also be helpful. Of course, you will also learn if your abilities will enable you to be a good researcher.

Remember, your decision to attend graduate school is not final; it does not have to be made prior to receiving your undergraduate degree. Some students receive their undergraduate degree and work as chemists or in other fields before deciding to attend graduate school. A break of a year or more can offer you a chance to gain practical experience before choosing a specialty.

Ciba Specialty Chemicals, 1998

On the other hand, once you start getting a regular paycheck, you may find it difficult to give it up for graduate school, particularly if you have a spouse and children. Some find it difficult to return to a study regimen; you may have to relearn some things from your undergraduate education.

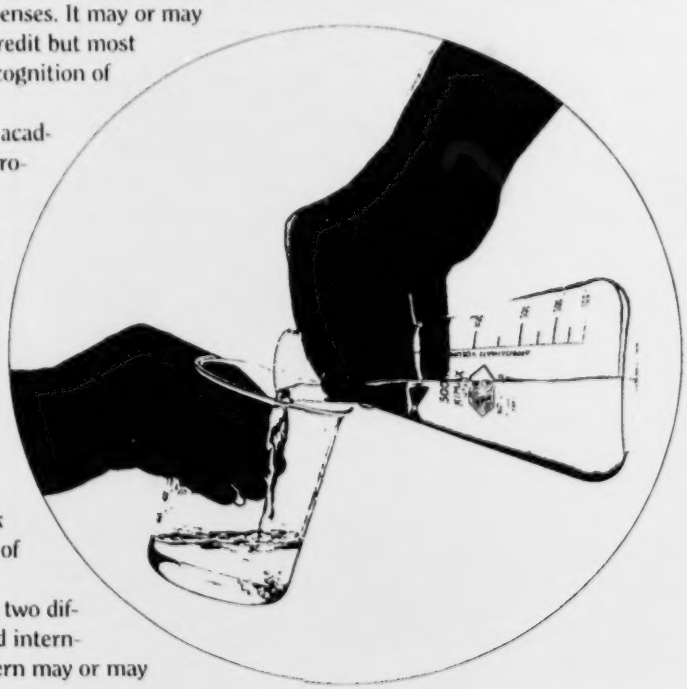
35A

Many companies cover continuing education expenses for employees. Chemists can take advantage of this opportunity to earn a master's or Ph.D. degree. Although some chemists work while attending graduate school, you may need a leave of absence from work to complete a Ph.D. program. Some companies pay for employees to obtain an M.B.A. or a degree in patent law.

Experiential Education

Some schools offer undergraduate and graduate experiential education programs that combine industrial work experience with academic programs. Experiential education covers a variety of experiences that are incorporated into an academic program. Cooperative education (co-op) and internships are included under this umbrella term as are programs in service–learning and study/work abroad. A major aim of these programs is to enrich and expand an academic curriculum with practical experience(s). The expansion may be directed toward the career goal of the participating student or it might be strictly for personal development. Industrial experience programs can help students learn what industrial work is like while they are still in school. The ACS Department of Higher Education publishes a directory of schools offering industrial experience programs (for more information, please visit the Education section at www.acs.org).

Cooperative education is an academe–industry partnership program that enables college students to participate in employer-paid work experiences in business, industry, government, and human services as part of academic training. It gives students an opportunity to apply academic theory to real work situations, acquire career experience, enhance personal growth, gain hands-on professional experience, and earn an income to help defray college expenses. It may or may not involve academic credit but most often includes transcript recognition of the experience.



Internship programs are academe–industry partnership programs that are carefully monitored work or service experiences in which a student has clearly delineated learning goals and reflects actively on what he or she is learning throughout the experience. Ordinarily internships are taken as part of a formal academic curriculum. Traditionally, internships are unpaid work experience for the duration of an academic term.

Generally, there are only two differences between co-ops and internships. The participating intern may or may

Benefits of Study/Work Abroad Programs

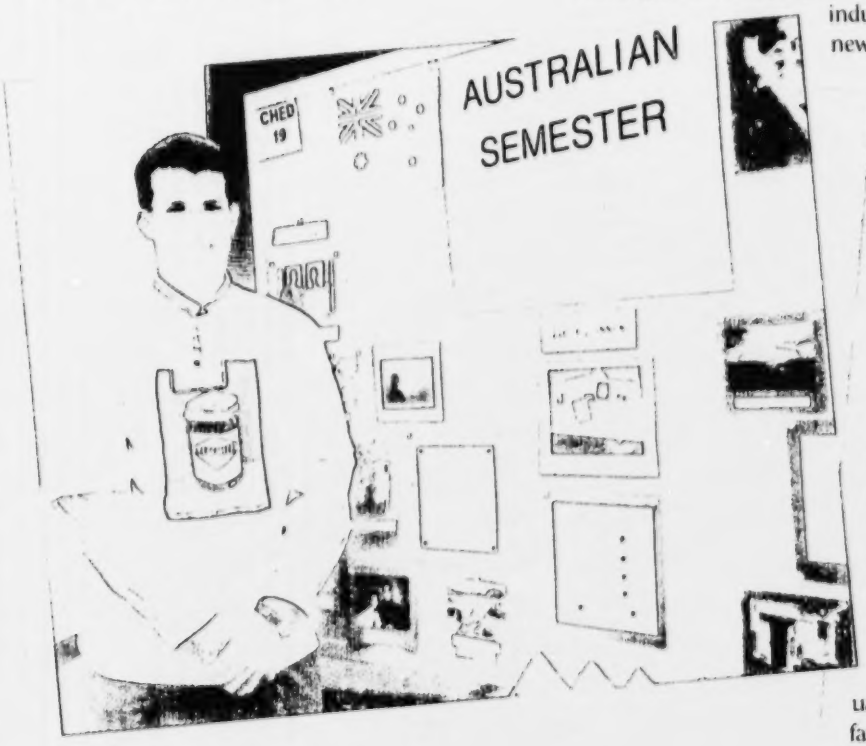
Study/work abroad students benefit from their experiences abroad because they

- ☐ learn that chemists can communicate readily with colleagues throughout the world,
- ☐ increase their attractiveness to multinational chemical firms,
- ☐ learn firsthand of alternative approaches to meeting life's challenges,
- ☐ learn to operate in an environment with different customs,
- ☐ receive the opportunity to broaden their intellectual and cultural awareness in a setting that fosters their independence,
- ☐ broaden their view of the world, and
- ☐ receive a deeper appreciation of political and societal events in other countries.

not be paid for the work, whereas the co-op student is paid. Commonly the intern spends the equivalent of only one school term at the professional pursuit, frequently toward the end of the academic career (a "capstone" experience), whereas co-ops alternate work and study throughout the year.

In study/work abroad programs, students have the opportunity to understand and function productively in science in a different culture. In service–learning programs, students provide science services to underserved communities across the nation and learn to assess how science and technology can be applied in a societal context. It is a monitored service experience in which a student has intentional learning goals and actively reflects on what he or she is learning throughout the experience. Service–learning programs emphasize the accomplishment of tasks that address community issues and include features that foster participants' learning about larger social issues and an understanding of the reciprocal learning and service which can occur between students and community members. Some projects might include drinking water analyses, lead sampling, other environmental assays, or tutoring.

Experiential programs can help you decide whether or not you like industrial R&D. It is becoming increasingly important in acquiring a permanent job to have had some industrial experience. Some major companies presently fill many of their full-time positions from internship and co-op rosters. Although each company has its own distinctive culture, industrial experience can help a new researcher get off to a fast start in the first job after graduation.



Dr. Cynthia Harwood, a graduate of the University of Texas at Arlington and currently a Senior Applications Scientist with Molecular Simulations Corporation, talks about her internship at Mobil Oil Company. "I felt much more prepared for what I might see and experience in industry. I have also found that having the internship on your résumé makes employers more interested in you as a job candidate." Dr. Paul Jacobs, a Senior Research Fellow with Johnson & Johnson Medical, Inc., adds, "Industrial internship experience during graduate studies is viewed very favorably when evaluating appli-

36A

cants for R&D positions." Lynn McDonald discovered another advantage to co-op programs. While earning a B.S. degree in chemistry from Illinois State University, McDonald worked for two semesters in the Central Research Department of Dow Chemical U.S.A. It helped her gain a full-time permanent position at Dow. She reports, "My starting salary was approximately 16% higher than those chemists without work experience."

An industrial experience program can help you learn about various chemistry careers and give you an opportunity to test and analyze your capabilities. If you find a career or specialty that really excites you, you can tailor the remainder of your curriculum to prepare yourself for this career. Also, you can gain useful contacts in industry who can serve as references and otherwise help you in your job hunting efforts. As McDonald's case illustrates, a successful co-op experience can turn into a job after graduation.

The ACS Division of Education and International Activities publishes the "Directory of Experience Opportunities," which is a listing of co-ops, internships, and other experiential positions offered by industry, government, and other types of organizations. The Division also publishes the "School Reference to Experiential Programs in Chemistry," which lists universities and colleges that offer experiential programs.

Educational Planning and Career Objectives

When beginning their careers, chemists with bachelor's degrees have a different choice of career options than do master's degree and Ph.D. chemists. Common career options for chemists with bachelor's degrees include but are not limited to chemical sales, working as a plant chemist, working in a quality control laboratory, or working as a laboratory technician. Careful choice of a minor or sequence of elective courses can be critical. The right choices can aid a B.S. or B.A. chemist in becoming a high school science teacher, working in chemi-

Communication Skills

Oral and written communication skills have become ever more important to chemists' career success. Chemists increasingly work in multidisciplinary teams and have to give oral presentations about their work to fellow team members. They must be able to communicate (orally and in writing) with those trained in their discipline as well as with those in different technical areas and with those who might not have technical training, for example, those in sales, advertising, upper management, law, and regulatory affairs. As outsourcing and joint research between two or more companies, or companies and universities, become more common, presentations are often made to people who are not chemists or who work for different companies. Increasingly, chemists present technical seminars to prospective customers and at industry conferences or trade association meetings.

Written communications remain important. Chemists frequently communicate by electronic mail. They write technical reports and operating instructions for co-workers and write and edit technical brochures and bulletins designed for customers. Many chemists correspond with government regulatory employees, and some chemists are required to write initial patent suggestions describing their invention to patent agents or patent lawyers. Some chemists help their employers design Web sites and transfer information to them.

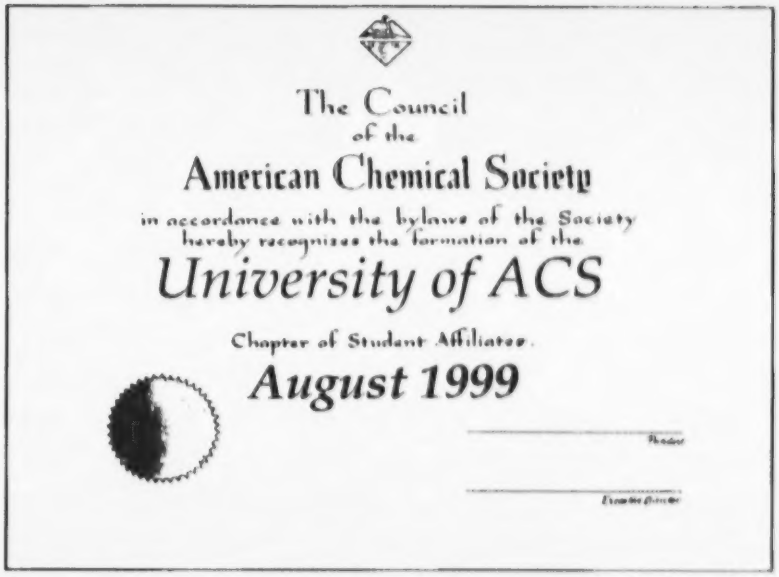
Good communication skills can help chemists advance further in their careers. Taking technical writing and journalism courses while still in school could help you develop these skills. Some schools offer public speaking courses. Another way to improve these skills is to join Toastmasters International or similar programs. Most people can improve their oral communication skills with practice.

cal sales, or beginning a career in chemical marketing. Helpful electives include various engineering courses, other science courses (such as biology, biochemistry, or computing), and courses such as business, marketing, chemical information, foreign languages, public speaking, and writing. Minors and electives can be most helpful if you have a particular career in mind. If this is the case, determine the educational requirements by talking with people currently in these careers. You can sometimes find these individuals through academic advisors, your college alumni office, college placement office, or your local ACS section.

Chemists with advanced chemistry degrees usually begin their careers with more specialized responsibilities than bachelor's degree chemists. They usually work in research or as college or university faculty members. Many of these positions are open only to M.S. and Ph.D. chemists. The greater the degree of specialization, the more likely it becomes that you will have to be willing to relocate to a different part of the country.

Many industrial research positions are open only to people with Ph.D. degrees. Career advancement is often more rapid for those having a Ph.D. degree. However, ability can substitute for advanced degrees. Executives at many companies began as laboratory technicians. Glenn Taylor, a former Shell Chemical Company research director, began his

career as a laboratory technician and later advanced to a position that is one step below vice-president of research. However, there is no question that, at most firms, advancement is easier and more rapid if you have an advanced degree.


The Council
of the
American Chemical Society
in accordance with the bylaws of the Society
hereby recognizes the formation of the
University of ACS
Chapter of Student Affiliates
August 1999

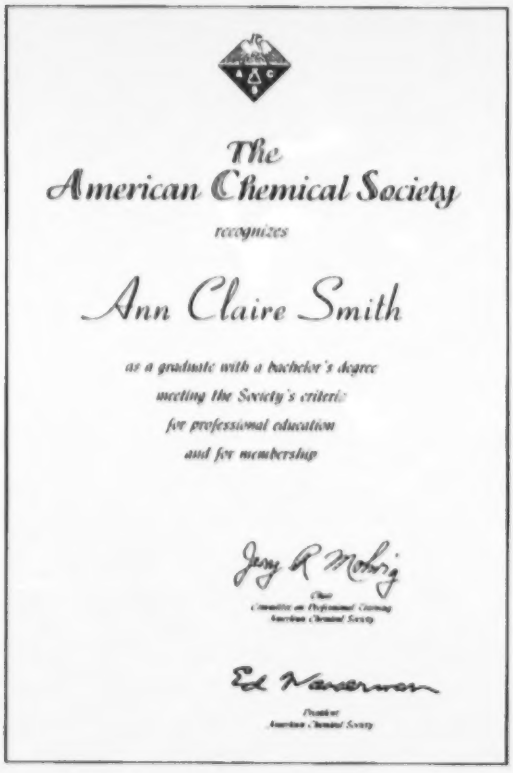
Chemists with advanced degrees in other fields may begin careers in interdisciplinary research. For example, a B.S. chemist may obtain an advanced degree in metallurgical engineering and begin a research career developing metal–ceramic composite materials. Chemists also open themselves up to other career opportunities by combining the undergraduate chemistry degree with an advanced degree in a nontechnical field. For example, with an M.B.A., a chemist may become a business manager or perform a business staff function.

Chemists with advanced degrees are usually paid more than chemists with bachelor's degrees. The ACS Department of Career Services performs a yearly survey of salaries of individuals in the chemical sciences and publishes the results in an annual review entitled "Salary Survey." A condensed version of this report is published in *Chemical & Engineering News*. Chemists with advanced degrees may initially have fewer career options than bachelor chemists. However, as they become more experienced, their career options broaden. They may enter new fields of research, become research managers, or become managers of various business functions.

Courtesy Inc.

Education Never Ends

A chemist's education never ends. In graduate school and throughout your professional career, you will have to keep up with current scientific literature, especially journals. Taking a chemical information course, if offered in your undergraduate program, would be helpful. Begin to acquaint yourself with the chemical literature by your senior year. This includes Chemical Abstracts and searching techniques for major online databases such as those provided by



The
American Chemical Society

recognizes

Ann Claire Smith

as a graduate with a bachelor's degree
meeting the Society's criteria
for professional education
and for membership

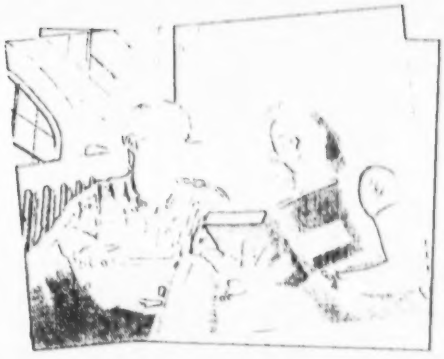
Jerry R. Mohrig
Chair
Committee on Professional Training
American Chemical Society

Ed Vaverman
President
American Chemical Society

STN International. Online information retrieval is becoming a necessary career skill, not only for researchers but also for those in other careers such as business management who also need access to chemical information. In addition, you must learn about and read the current books and journals in your field. Also, read the classic books and monographs in your field, which are very well written and also serve as outstanding examples of written technical communication skills.

Researchers will need to keep up-to-date on more than purely chemical subjects. Many researchers study to update and expand their computer and communications skills. Books, articles, and short courses on working in teams, personal productivity, time management, and project management are popular with many industrial chemists whether or not they work in research.

6 GRADUATE SCHOOL CONSIDERATIONS



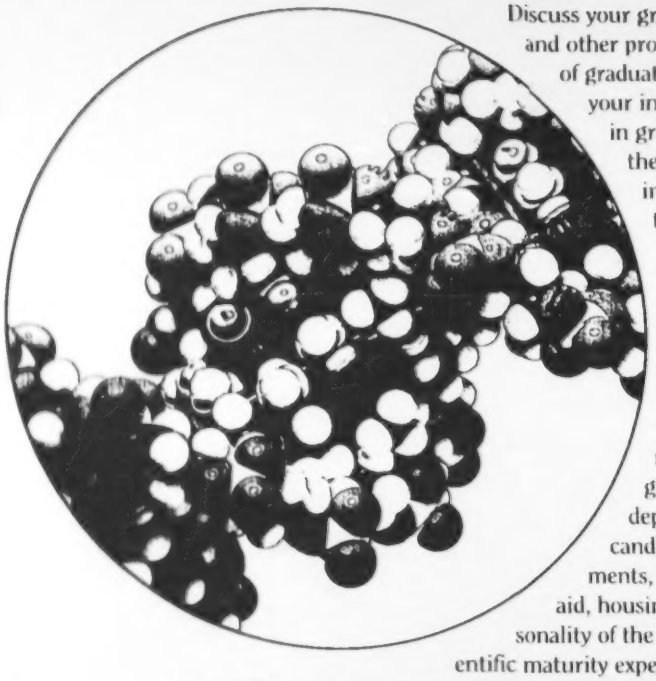
Graduate training is necessary to gain the proficiency in the discipline required to become a participant in chemical research and the development of new knowledge. The Ph.D. program is designed to help you develop critical thinking skills and to provide guidance in developing creative approaches to problem solving through experience in chemical research. This training is designed to lay the foundation for professional work involving research in industry or a research institute or for teaching and research in a college or university environment.

Preparation for graduate school begins in your undergraduate program. In addition to acquiring your undergraduate degree, it is important that you acquire computer skills, good problem-solving skills, effective teamwork skills, and good oral and written communication skills. Take the opportunity to do undergraduate research and participate in internship programs.

You should enter graduate studies knowing what you want to accomplish and consider your goals and abilities in relation to those required for success in graduate school. Once you've decided you have the abilities and commitment to succeed in graduate school, you will have to decide on which schools to apply to, complete application materials, gain admission, and decide how to finance your graduate education.

Selecting a Graduate School

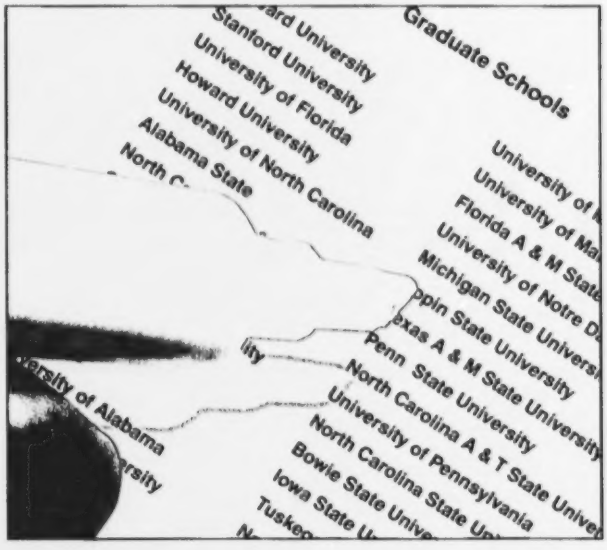
Graduate schools differ greatly in their degree programs. Carefully review graduate school catalogs and the research interests of the faculty members. Many universities now have Web sites. By consulting them, you can get at least an introduction to various graduate programs. The ACS "Directory of Graduate Research" provides detailed information on chemistry departments, including faculty size, research interests of faculty members, and recent faculty publications. Another ACS publication, "Planning for Graduate Work in Chemistry," provides valuable information about chemistry graduate school programs.



Discuss your graduate school plans with your faculty advisor and other professors at your undergraduate school, alumni of graduate schools, and campus recruiters. Also discuss your interests and options with acquaintances already in graduate schools. Do not feel bound to enroll in the graduate program at your undergraduate institution. A change of schools will expose you to people with different attitudes about chemistry and research and widen your circle of academic contacts. Changing schools will enable you to experience different educational approaches and will provide the stimulus of a new and different environment as well as new approaches to problem solving.

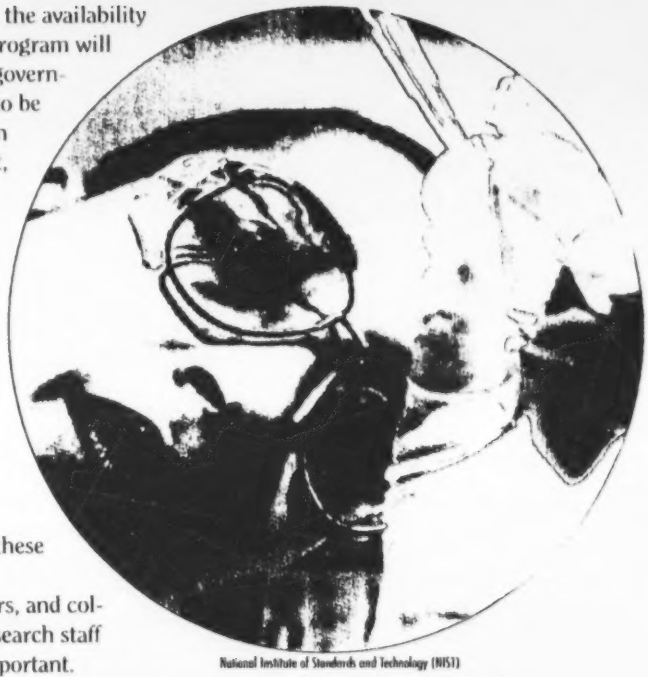
Visit graduate schools to talk to faculty members and graduate students about their graduate programs, research facilities, and department policies. Ask about proficiency exams, candidacy or cumulative exams, language requirements, teaching assistantship requirements, financial aid, housing, and application procedures. Assess the personality of the department, including factors such as the scientific maturity expected of the graduate students, interaction among different research groups, and the variety and vitality of departmental activities. One way to perform some of these assessments is to attend one or more department seminars or colloquia. If a professor from one of your candidate graduate schools is scheduled to visit your undergraduate school and present a colloquium, call and ask for an appointment to discuss the speakers' graduate school program. Attend the colloquium and assess the speaker's capabilities.

When deciding which schools to apply to, evaluate faculty members as potential research advisors. The core of your training will be your thesis work and what you learn in the course of it. Thus, the capabilities of your research advisor and your relationship with him or her will be critical to your graduate school success, the professional attitudes you form, and the development of your scientific insights and skills. In making your final decision on a graduate school, remember that you may not be able to work for a particular professor for a variety of reasons. For example, the professor may lack research funds to take on an additional graduate student or may be planning a sabbatical leave. You may also find that you and the professor do not have the personal compatibility required for a rewarding, enjoyable working relationship. For these reasons, you should consider the research interests of other members of the department and have a second choice among the faculty members before making a final decision on your choice of graduate school.



Those considering graduate school should ask about financial aid, housing, the job placement of graduates (if you cannot get this

information, you have identified a problem), the availability of experiential education, and whether the program will prepare you for an industrial career, one in government or academia, or for whatever you feel to be your primary career goal. Ask about program requirements; they are not to be avoided but, in fact, they help to ensure that you will receive a solid education. Beneficial requirements include qualification examinations to evaluate your readiness for graduate work (particularly at that school), courses in more than one area of chemistry, written and oral propositions for candidacy, and an expectation of periodic presentation of your research progress. Graduate programs clearly recognize the need to recruit bright, perceptive students and are likely to be favorably impressed by prospective students who ask these kinds of questions.



National Institute of Standards and Technology (NIST)

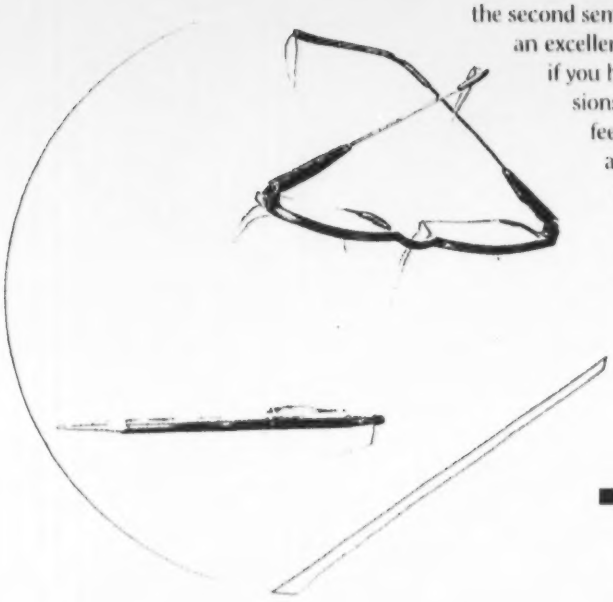
The department's formal courses, seminars, and colloquia and your interactions with faculty, research staff members, and other students will also be important. Understanding and appreciating fields of chemistry outside your specialty are important factors in your intellectual growth. Another factor growing in importance is the opportunity to engage in interdisciplinary research. This research is often sponsored by two or more departments. For example, exciting work in the new field of atomic force microscopy is occurring in electrical and mechanical engineering departments. A prospective graduate student wishing to develop an expertise in this technology should learn what interdisciplinary research opportunities are available at various graduate schools. Other examples of programs that may be interdisciplinary are biotechnology and materials science.

You may also wish to pursue graduate study in a field other than chemistry. Many bachelor's degree chemists enter graduate programs in biochemistry or biotechnology, chemical engineering, information science, computer science, pharmacology, materials science, health sciences, forensic science, law (particularly patent law), business, or journalism.

When you are ready to apply for admission to graduate school, narrow your choices to three to six schools. This gives you a range of options while reducing the expense, time, and effort associated with submitting multiple formal applications.

Admission to Graduate School

After developing your final list of graduate schools, contact the department chairs of these schools and ask them for their admission requirements and application forms. You should do this no later than the beginning of your senior year; you can write or contact the departments through their Web sites. You should complete and submit your applications by the start of



the second semester of your senior year. The time between semesters is an excellent opportunity to complete and submit your applications if you have not already done so. Many schools have early admissions programs that can reduce the stress and concern you feel while waiting to hear if you have been admitted. Take advantage of these by submitting your application materials early. However, do not rush these out. Treat them like job applications and résumés. They should be letter-perfect. Cover letters and long responses to questions should be examples of your best writing.

The three main criteria graduate schools use in estimating your potential and deciding whether to admit you are

- your undergraduate transcript, particularly the science courses you took and the grades you earned.
- letters of recommendation, particularly from professors in the area you are interested in studying. A recommendation from an undergraduate research advisor or a research advisor in your co-op program can be particularly valuable.
- the Graduate Record Exam (GRE). The GRE includes a standard verbal, quantitative, and analytical examination similar in concept to the Scholastic Aptitude Test (SAT) many high school students take to apply for college admission. Many graduate schools require the additional GRE test in chemistry and weigh this more heavily than the other GRE exams.

You should take the GRE in the first semester of your senior year. Do this even if you do not have immediate plans for graduate school. Scores are good for five years, and taking the exam could be helpful if your graduate school plans change.

Financial Aid

Although your choice of a graduate school should not depend on financial considerations only, money concerns are important. Most chemistry graduate students obtain full or partial tuition scholarships. Teaching assistantships and research fellowships will provide you with a modest but usually adequate allowance for living expenses. Financial aid is available from university funding and research assistantship funding from your thesis advisor's research grant money. Also, competitive fellowships are offered by the National Science Foundation, the National Institutes of Health, other government agencies, and some companies. These grants are normally awarded to advanced graduate students. The department chair or administrator can help you collect information on such funding opportunities. Education loans, often guaranteed by the government and repayable over long periods of time, are another financing option.

7 JOB HUNTING

Conducting an effective job search is challenging and rewarding provided it is approached correctly. Getting a job is a job! Just as the correct information and equipment are needed to perform an experiment, so the right tools are needed when looking for a job. The right instruments make an experiment work and give more accurate results; so too you will get positive results from your job search if you use the right tools to conduct your search.

Your career as a professional chemist begins with your first job. You should begin your job hunt about a year before graduation by assembling a list of companies you would like to work for and people at each company to contact. The summer before your final year is a good time to start. Plan to visit a local library to obtain information on potential employers. Also read at least one good book on job-hunting techniques. The American Chemical Society publishes several brochures tailored for chemists that help you target the job market, write your résumé and cover letter, and interview more effectively. These publications are listed in Appendix 2 of this booklet.

Consult with people at your campus placement office or center to obtain advice about your job hunt. Many placement centers arrange on-campus interviews with corporate recruiters who visit your school. They can also provide guidance in writing your résumé and cover letter. In addition, they can provide counseling and moral support. Also discuss your job-hunting and career concerns with professors, particularly faculty advisors.

Self-Assessment

Begin looking for job leads after you have done a personal assessment. You should consider the following questions:

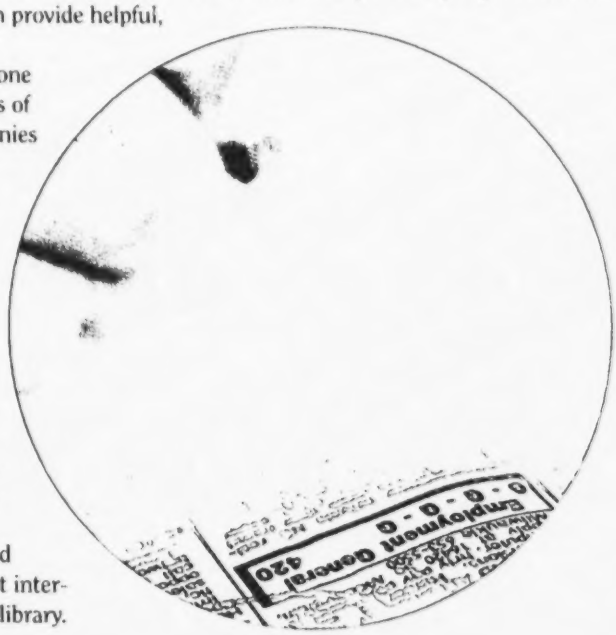
- ☐ What are your goals?
- ☐ What are the skills you bring to the job?
- ☐ What type (or types) of job do you want?
- ☐ What type of working environment do you prefer?
- ☐ What are your geographic limitations (if any)?

Assessing your professional and personal ambitions and goals tells you what you want from an employer and co-workers; then you can use the answers to the questions above to decide what job best meets your needs and desires. The better you know yourself, the better prepared you will be to sell yourself to the right employer and to choose the right job. The self-assessment exercises at the end of this book (Appendix 1) will also help you in choosing a career direction.

Job Leads

You can identify job leads by

- ☐ Checking with your campus placement office to determine which corporate recruiters will be visiting campuses and when. It can be helpful to take several "informational interviews" with corporate recruiters to find out what an interview is like and to practice your skills. You might even stumble on a job you had not thought about. Your placement office will have publications such as "The College Placement Annual," which provides information on many companies, what types of job openings they have, and the personnel manager's name and address.
- ☐ Utilizing what is available from the ACS Career Services Department.
- ☐ Consulting the Additional Resources section (Appendix 2) of this book for useful publications you can obtain from ACS, many for free.
- ☐ Consulting with family, friends, and faculty members for the names and telephone numbers of professionals who are in the chemical sciences field you are interested in or who are working for companies you might want to work for. Do not neglect recent chemistry graduates from your school and fellow students who have had internship or co-op experience. In addition to job leads, they can provide helpful, up-to-date job-hunting tips.
- ☐ Checking newspapers, telephone "Yellow Pages," and chambers of commerce listings for companies who employ chemists.
- ☐ Visiting your library and reviewing publications such as *Peterson's Guide*, *Dun and Bradstreet*, *The Thomas Register*, and *Moody's Industries* for general descriptions of various corporations and "Directory of American Research and Technology" for descriptions of 15,000 laboratories in the United States. Also, consult books on writing résumés and cover letters and employment interviewing while you are in the library.



☐ Checking the Internet. There are many job sites available on the World Wide Web. An annotated list of career-related Web sites is available from ACS Career Services. Do not neglect the home pages of companies you would like to work for. These pages provide useful information on the company and its products, and some include information on available job openings. Some publications such as the *National Business Employment Weekly* have articles on using the Web in your job search.

Networking

An important job-hunting strategy that can serve you well throughout your career is called networking—a process of building your contacts and exchanging job-related information. About two-thirds of jobs are found through networking whereas only approximately 15–20% are found through the classifieds. The rest are uncovered using other methods, such as search firms. When you network, have three goals: information, which includes learning about each contact's industry and the types of jobs that are needed; ideas to help you develop effective job search strategies; and introductions to others who can help you by providing more information, ideas, and introductions.

Remember that everyone has a network. However, not everyone knows how to define or use it. A network consists of everyone you, the job seeker, know, plus everyone those people know. Think of all the people you come into contact with, not just those whom you see every day: professors, classmates, vendors, neighbors, relatives, physicians, dentists, lawyers, just to name a few. Everyone is connected to some extent, even those who think they have no connections at all. You can develop networks at professional meetings and by keeping in touch with alumni.

Networking is not an occasional phone call. It is a way of life, whether or not you are searching

ACS Career Services

ACS Career Services provides a unique collection of programs, services, and publications specially designed to assist ACS members and affiliates with their job searches. These services include

☐ Professional Data Bank, a year-round computerized registry, matches qualified candidates to employers' specific job requirements. The PDB is designed to give maximum exposure to the top scientific recruiters in the country. All you need to do is complete an information summary form (available from ACS Career Services), send it back with a copy of your résumé, and you will become part of the PDB.

☐ ACS Employment Clearing House provides ACS members and ACS student affiliates with exposure to positions posted and the opportunity to interview with employers on site during ACS national and regional meetings. The service is free, but you must be registered for the meeting you are attending.

☐ ACS Job Bank puts weekly postings at your fingertips, including the previous and current weeks' postings from *Chemical & Engineering News* (*C&EN*). Simply visit www.acs.org. The Job Bank is also hotlinked to CareerPath, which allows you to search nearly 50 metropolitan newspapers for positions in chemistry.

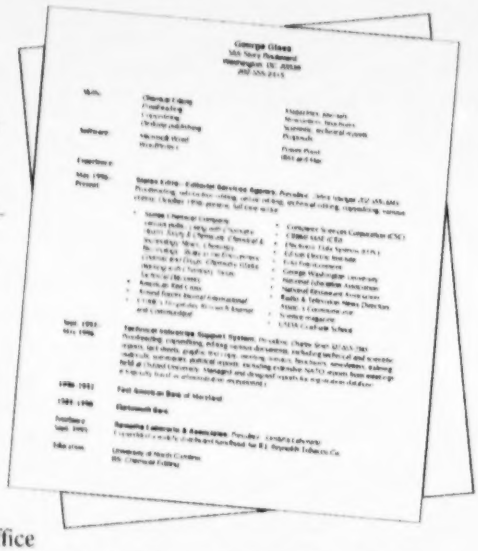
☐ ACS members and affiliates who are unemployed as well as student members and affiliates who have not found employment two months prior to graduation can place free "Situation Wanted" advertisements in *C&EN*.

☐ Career Services makes available at ACS national meetings a number of free programs for job seekers: mock interview sessions, résumé reviews, and workshops and presentations designed to provide assistance in fine-tuning your job search skills and to offer information on the current status of the industry.

For more information and a copy of their free catalog, contact ACS Career Services at (800) 227-5558, or e-mail career@acs.org. Or, visit the Career Services Web site at www.acs.org/careers.

for a job. Networking is critical because to hunt for a job effectively, you need to be in more than one place with your eyes and ears wide open—this is just not possible! But your contacts, if they know what you are looking for and if you have enlisted them to keep their eyes and ears open on your behalf, can job hunt for you. By staying in touch with your network and letting them know that you are interested in job leads, you can get a jump on the job market.

Your Résumé and Cover Letter



The best time to prepare your résumé is during the summer before your senior year. You will have more time to conduct a self-assessment, to consider what types of jobs you would like, and to assemble the information on your qualifications and accomplishments. You can also request permission from the individuals you would like to use as references. Your résumé is the first example prospective employers will have of your communications skills, so it should be well organized and well written. Your résumé should outline your experience, interests, abilities, and goals and should emphasize your accomplishments. Limit your résumé to no more than two pages. You can list publications and references on supplemental pages. Reference books at your library or placement office can provide models of résumé content and format. Your format should contribute to the clarity and readability of your résumé. The publication "Tips on Résumé Preparation" is available from ACS Career Services.

If you are uncertain about your career goals, prepare a separate résumé tailored for each career goal. For example, you might prepare one version for the petrochemical industry and one for the pharmaceutical industry. The résumé you develop for the pharmaceutical industry could emphasize your interest in biochemistry and the biochemistry courses you took. Another résumé could emphasize courses more relevant to the petrochemical industry such as physical chemistry and catalysis chemistry courses.

New technologies such as scanner hardware, optical character recognition (OCR) software, and retrieval software allow your résumé to be electronically scanned, prescreened, and stored for later reading by a recruiting or hiring manager. In most large companies, résumés are entered directly or scanned into the computer. When an opening occurs, the computer scans résumés by keywords. If you do not take this important new approach into consideration when preparing your résumé, your résumé may be out of the running. The ACS Career Services' "Tips on Résumé Preparation" discusses the electronically scanned résumé and rules to follow to prepare a résumé for scanning.

Your cover letter should be more than just a note saying, "Here is my résumé." Nor should it simply restate what is in your résumé. Your résumé tells who you are: a graduating chemistry student with certain experience, abilities, and accomplishments. Your cover letter should tell employers who you are through both its content and tone. It should demonstrate that you are a productive, accomplishment-oriented individual with good written communications skills. It should be no more than one page.

48

Skills and Traits Employers Want

To compete effectively in the changing job market, job seekers trained in the chemical sciences need to emphasize more than just their technical skills. Regardless of the employment sector, employers are looking for individuals who have the skills and traits below (not necessarily in the order listed). Providing evidence of some of these skills and traits in your résumé or cover letter may benefit your job search.

Mastery of chemistry

☐ how research is done ☐ where to get information ☐ lifetime learners

Breadth of knowledge of science

☐ broad-based knowledge ☐ specialists who can switch fields
☐ increased learning outside chemistry (e.g., biosciences or engineering) ☐ multidisciplinary training

Problem-solving ability

☐ customer orientation ☐ multidisciplinary approach ☐ teamwork

Flexibility and versatility

☐ able and willing to learn new things quickly ☐ able to perform multiple tasks ☐ growth into broader interdisciplinary areas

Computer literacy

☐ computerized instrumentation ☐ knowledge of computational chemistry ☐ modeling applications

Practical experience

☐ co-op, internship, or summer work

Initiative and follow-through

☐ innovative, self-motivated, assertive, and self-starting ☐ curious, industrious, energetic ☐ strong work ethic, enthusiasm, positive attitude

Communication skills

☐ communicate clearly, concisely, and convincingly, orally and in writing ☐ listening skills ☐ ability to relate technical issues to business context

Interpersonal skills

☐ comfortable with a diversity of people ☐ able to work in multidisciplinary teams ☐ effective negotiator

Leadership skills

☐ able to lead a team and be a team player ☐ project management skills

Business orientation

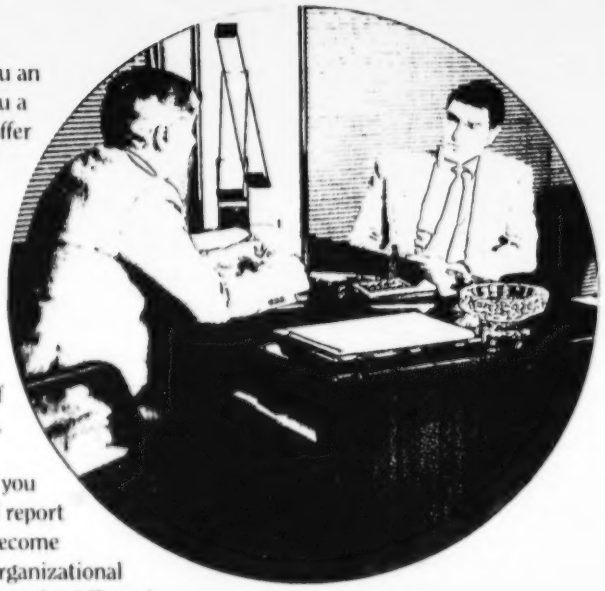
☐ some knowledge of business or economics ☐ business sense ☐ economic sense ☐ manufacturing sense
☐ marketing knowledge is a plus ☐ selling skills (i.e., ability to sell ideas to management)

Other skills

☐ knowledge of safety principles ☐ knowledge of the patent system ☐ language skills, especially knowledge of more than one language
☐ integrity, ethics, work orientation, risk-taking ☐ knowledge of experimental design and statistical analysis of data

Source: *Current Trends in Chemical Technology, Business, and Employment*, ACS, 1994.

Employment Interviews



Your résumé and cover letter will get you an employment interview; they will not get you a job offer. The critical step in getting a job offer is the employment interview. Expect some nervousness and anxiety as you approach this critical step in your job hunt. Preparation and practice can reduce your concerns. Begin preparing by reviewing your résumé thoroughly so you will not need to refer to it during your interview.

Carefully review all your correspondence to be sure you understand the type of job opening for which you are interviewing. If this is not clear, telephone the hiring authority to obtain this information. When you call, ask for a copy of the company's annual report if you do not have one. This will help you become familiar with the company's business and organizational goals. The company's public relations office or the Office of Shareholder Relations will probably be able to provide the annual report and additional information. Visit your library and consult *Peterson's Guide, Dun and Bradstreet, The Thomas Register,* and *Moody's Industries* for more information. For very recent information, consult the company's home page on the World Wide Web. Also, search the Web using the company name as your keyword. You may be able to locate magazine and newspaper articles on recent developments at the company.

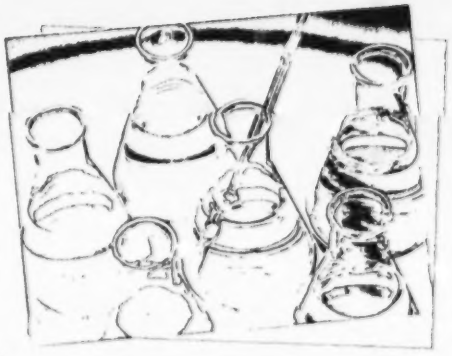
Review the names of the people who will interview you listed on your interview schedule. If you can, determine their positions in the company. If you cannot obtain this information in advance, ask your interview host for it prior to your first interview. Consult with your references and professors to see if they know one or more of the people listed on your interview schedule. Find out as much as you can about them. Do a literature search to see what recent technical articles have been written by people on your interview list. Read at least the abstracts of these articles and be prepared to ask a question relating to them. Your interviewer will be flattered, and your question will demonstrate that you have prepared carefully for the interview.

Dress appropriately for the interview wearing conservative business attire. Avoid flashy accessories and jewelry. Be prompt. Be enthusiastic and energetic during your interview. Sell yourself while avoiding the extremes of exaggeration and false modesty. Be positive and honest. Do not smoke and do not drink alcoholic beverages if you are taken to lunch.

After your interview, be sure to send a thank-you letter to each of the persons who took part in the interview process. If you request business cards from each person with whom you speak, you will be able to use the correct titles and spelling of their names when you write your letters. The courtesy of a thank-you letter can reinforce the impression you have made. Mentioning a few points that you particularly appreciated in the interview and stating your continued interest in working for the organization are also appropriate.

8 CONCLUSION

A chemistry degree is a powerful springboard to launch you into a fascinating and rewarding career. This booklet briefly sketches the many possibilities awaiting those who hold degrees in the chemical sciences; how best to prepare for careers in different fields and different environments such as industry, government, or academia; and where to get further information that will help in defining career objectives. Now it is up to you to apply this information to your own career preparation.



You have learned something about the wide variety of careers in industry, government, and academia that a chemistry graduate is able to pursue. Some of these include

- ☐ laboratory research and development in industry,
- ☐ analysis and testing,
- ☐ management of laboratories, research groups, businesses, or production facilities,
- ☐ sales and marketing,
- ☐ chemical information science,
- ☐ technical writing,
- ☐ patent law,
- ☐ computer applications (process control, modeling, software development, etc.),
- ☐ government regulations,
- ☐ industrial hygiene,
- ☐ teaching in colleges or universities, high schools, or elementary schools,
- ☐ academic research,
- ☐ research and other services in federal, state, or local government agencies, and
- ☐ science policy analysis.

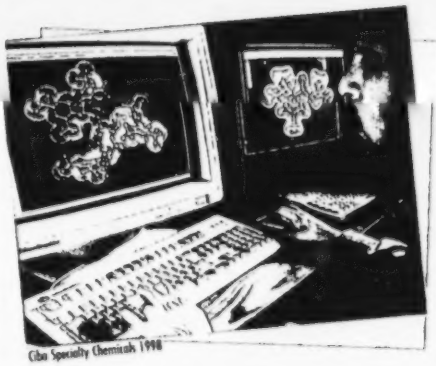
In addition to the above careers, chemistry serves as an important preparation for professional studies in other fields such as medicine, dentistry, and law.

You have taken an important step in preparing for a rewarding career in the chemical sciences by reading this booklet. We hope this information proves helpful and encourage you to broaden your awareness further by consulting the Self-Assessment section that follows (Appendix 1) and the list of additional career resources (Appendix 2).

APPENDIX 1: CONDUCTING A SELF-ASSESSMENT

An important step in charting a career course in chemistry is undertaking a self-assessment. We are all unique individuals, so there is no single answer to choosing a career. To make decisions that determine your career direction, you must know, understand, and be able to articulate your

- ☐ skills,
- ☐ interest areas,
- ☐ personal style and characteristics, and
- ☐ professional values.


Ciba Specialty Chemicals 1998

This self-assessment section provides you with the opportunity to explore these areas. Once you have conducted a self-assessment, use this information to help you decide whether or not to enter the job market directly after college or attend graduate school, and to identify which chemistry disciplines, environments, and fields best suit you. Ask yourself which areas best fit your skills, interest areas, personality, and values. Where do you see yourself working, advancing, and making a transition—from and to?

Degussa Corporation

Because today's job market is so competitive, it is recommended that you conduct your job search in more than one area.

Some of you will come away from your exploration and research with "the" answer. Others will come away with interests in several areas. Either way, because today's job market is so competitive, it is recommended that you conduct your job search in more than one area so that you have options for more than one employment opportunity—in case your first choice is not available. Prioritize your search and spend most of your time seeking opportunities in the most important areas. For more information on the actual job search process, contact the ACS Department of Career Services at (800) 227-5558 or by e-mail at career@acs.org.

One last thought before you begin your journey. Regardless of where you begin your career, the path you travel is likely to have many turns, twists, and unexpected surprises—pleasant and unpleasant. The Bureau of Labor Statistics reports that Americans can expect to work 30, 40, or even 50 years during their lifetimes in

seven to ten jobs that span three to five careers. You may end up someplace doing something that you never conceived of or thought possible. The challenge is to control your ability to live out your professional values, keep the career decision making yours as much as possible, and remain gainfully employed throughout your working years.

You can maintain control over your career and professional development by being as prepared as possible for life-long employment and accepting responsibility by

- ☐ conducting an annual self-assessment,
- ☐ updating your résumé annually,
- ☐ keeping your technical and functional skills current,
- ☐ keeping up in your field and related fields, and
- ☐ making a commitment to lifelong learning.

THE SELF-ASSESSMENT PROCESS

The counseling or career center on your campus provides many different types of self-assessment tools. Take advantage of them, especially if there is an area that you want to explore more deeply than is possible here. Also, talk to as many professionals, peers, and even family members as you can about career options and about your self-assessment findings. Solicit their feedback in your decision making.

The challenge for chemists in using any kind of self-assessment instrument is that such aids are not chemistry-specific. The tests normally guide you into a broad career category like science, accounting, or teaching. So our best prescription is (1) get to know yourself better through skills, interest, personality, and values evaluation; (2) read about the different laboratory and nonlaboratory careers, identifying those that appear to be aligned with your profile; and (3) talk to as many people in chemistry or chemical-related work as possible to gain information and insight. The combination of these exercises will, again, help you in choosing a career path.

Vulcan Materials Company

Your Skills

Why take time to identify your skills and accomplishments? Clearly identifying your skills and accomplishments will help you to

- ☐ compare your skills set with the requirements of a particular job,
- ☐ match the needs of the market as well as market yourself,
- ☐ identify areas in which you need to increase your skills,
- ☐ write your résumé,
- ☐ give you confidence,
- ☐ answer interview questions, especially "what can you do for us?"
- ☐ help you decide if your skills indicate whether to continue your education and earn an advanced degree in chemistry or seek a job opportunity that matches your skills.[4]

The process of identifying your skills and accomplishments is not something you should rush to finish in a few hours. You will obtain better results if you allow the evaluation to evolve over a period of weeks. Find a quiet place where you can sit and think about what you have done in your personal life, work experiences, and at school. Jot down on a piece of paper (or at the computer) the accomplishments that come to mind. Write down whatever you can recall.

Modest accomplishments are still accomplishments. When you think you have listed as many accomplishments as you can, look at the list and think about what skills you have that allowed you to be successful. Write down whatever those skills may be: computer skills, communication skills, leadership skills, analytical or technical skills. Now assign each accomplishment to one or more of these skills categories. For example:

Leadership Skills

- *President of Alpha Chi Sigma*
- *Served on college search committee for Chemistry Department Chair*
- *Assisted with SAACS outreach project to minority students in elementary school*

Communication Skills

- *Presented poster with advisor at ACS national meeting*
- *College newspaper reporter*
- *Tour guide for college admissions office*

Technical Skills

- *High comfort level and interest in lab portions of courses good grades in laboratory*
- *Undergraduate research or independent study in senior year*
- *Undergraduate laboratory assistant in stockroom or laboratory*

Computer Skills

- *Use Lotus, Excel, Microsoft Word, PowerPoint*
- *Programming in BASIC and FORTRAN*
- *Internet search skills*

Continue to edit and modify the list until you are satisfied. When the exercise is over you will be left with a list of your skills, backed up by examples (your accomplishments), which you can use in career decision making. This information is also essential for writing cover letters and your résumé and to prepare for interviews.

Interestingly, you may have strong skills in some areas that really do not interest you and vice versa. For example, your independent study may have indicated that your technical skills are very strong, yet you have little interest in a laboratory research position. However, you really liked writing for the college newspaper. In this case, you may want to consider a career in technical or science writing. On the other hand, your skills and interest may be in the conceptual part of chemistry and in the laboratory, which would indicate that you should consider graduate school.

Now you have a skills list. The next questions are, "How do I know where I can apply these skills?" and "What kind of employers are seeking my skills?" To answer these questions, read through the ACS "Chemical Careers in Brief" booklet; check job ads in such publications as *Chemical & Engineering News* or your local newspaper; if you are an ACS member, see positions posted on the ACS Job Bank; and talk to professionals.

Your Interests

In deciding your career path, not only do you need to consider what you can do—your skills—but also what you like to do—your interests. Because your interests may overlap several different career options, this consideration is an important component of your job search.[5]

Again, you are strongly encouraged to use the interest assessment tools in your college counseling and career center and to meet with a professional from that office to review the results. What follows is a quick exercise to open your mind to what is possible with your chemistry degree.

Pick a total of 10 words that best represent your interests from the four columns below.

A	B	C	D
Connecting	Assembling	Administrating	Analyzing
Creating	Constructing	Advising	Arranging
Designing	Desktop publishing	Appraising	Auditing
Developing	Drafting	Collaborating	Balancing
Drawing	Examining	Consulting	Budgeting
Innovating	Growing	Coordinating	Categorizing
Inventing	Inspecting	Counseling	Collecting
Planning	Maintaining	Negotiating	Computing
Problem-solving	Operating	Organizing	Correlating
Questioning	Producing	Selling	Editing
Recommending	Sorting	Serving	Forecasting
Summarizing	Testing	Supervising	Recording
Writing	Tooling	Teaching	Researching

The column that contains the majority of your selections is considered to be your primary interest area. Possible occupations are listed under each interest area. Note that these are far from comprehensive. The goal of this exercise is to help you direct your focus and stimulate your thoughts about career options to explore.

A—IDEAS	B—THINGS	C—PEOPLE	D—DATA
Advertising rep	Aerospace engineer	Account executive	Accountant
Architect	Communication equipment operator	Activities director	Archivist
Cartographer	Computer technician	Business agent	Auditor
Chemist	Industrial engineer	Buyer	Bookkeeper
Computer programmer	Installer	Career counselor	Controller
Development rep	Laboratory technician	Conference planner	Credit manager
Draftsperson	Maintenance engineer	Customer service rep	Data entry operator
Economist	Quality line worker	Contract negotiator	Document analyst
Forecasting specialist	Surveyor	Employee assistance specialist	Editor
Graphic artist	Service technician	Instructor	Information services specialist
Industrial engineer	Systems engineer	Interviewer	Investments specialist
Interior designer	Telecommunication technician	Legislative liaison	Librarian
Market research analyst	Test engineer	Logistics manager	Loan officer
Photographer	X-ray technologist	Management development trainer	Proofreader
Policy analyst	Systems training specialist	Merchandiser	Research agent
Political scientist		Personnel director	Research retrieval specialist
Psychologist		Procurement specialist	Transcriber
Social scientist		Public affairs specialist	
Statistician		Public health educator	
Strategic planner		Purchasing agent	
Technical writer		Recruiter	
Theorist		Sales representative	

You may be thinking that the occupations under the major interest categories are not all related to chemistry. Think again. Although it is true that most of these occupations are nonlaboratory careers, they can be related to chemistry. For example, let us say that your skills assessment tells you that you have strong writing skills and your interest assessment indicates you like dealing with ideas. A good career fit for you may be technical writing for a scientific publication such as Chemical & Engineering News or working in public relations for a chemical company. Both of these occupations are chemistry-related. Start to combine your skills and interests and think about how to apply these broadly in science-related areas. Almost all of the occupations above are found in science.

Some other examples of matching skills and interests in science follow:

SKILL	INTEREST	OCCUPATION
Organizational	Ideas	Manager of chemistry division
Math	Ideas	Software development for computational chemistry in pharmaceuticals
Computer	Things	Telecommunications developer for space program
Laboratory	Things	Analyst in a forensic laboratory
Communication	People	Account executive for instrumentation company
Technical	People	Campus recruiter specializing in technical recruitment for a consumer products company
Research	Data	Information specialist (chemical literature) for chemical manufacturer
Analysis	Data	Wall Street analyst specializing in chemical companies

Your Personal Style and Characteristics

Good communication skills have always been valued by employers but, in today's workplace, the ability to communicate well has taken on increased significance. You will be required to work and communicate with a variety of people during your career: managers; subordinates; people working in disciplines other than your own such as engineers, biologists, lawyers, and sales and marketing personnel; and people who are from different cultures. In short, there is hardly a job that does not require proficiency in either oral or written communications, or both.

To communicate effectively there are three things you must do: Understand your own communication style, understand what information the other person needs, and communicate with people with their informational needs in mind. Misunderstandings occur because two people are communicating on different wavelengths. How you communicate depends on your own style; so, the more information you have about your communication style and others' styles, the easier it will be to communicate effectively.

There are a number of books and tests to determine an individual's preferred communication style. This section will briefly explain one instrument, the Myers–Briggs Type Indicator (MBTI).*

The MBTI helps people understand themselves and their behavior as well as the behavior of others. The MBTI was developed by Katharine Briggs and Isabel Myers based on the work of Carl Jung, the Swiss psychologist. The MBTI looks at eight personality preferences that everyone uses at different times. These preferences are organized into four pairs; when you take the MBTI, the four preferences that you identify as being most like you are combined into what is called a type.

The four scales measured by the MBTI are as follows:

Extroversion—Introversion: How do you orient your energy? Do you take your energy from other people, things, and activities or draw it from within?

Sensing—Intuition: Do you prefer to take information in through your senses or do you prefer to rely on hunches and intuition?

Thinking—Feeling: Do you prefer to organize and structure information to decide logically and objectively or to decide subjectively, based on your values?

Judging—Perceiving: Do you prefer a planned and organized life, or one that is spontaneous and flexible?

If you are interested in taking the MBTI, or any other instrument to determine your communication style, speak to someone in your counseling or career center. You must take the MBTI from someone who is trained and certified to administer the test and interpret the results for you.

Remember, identifying a communication style is not the whole solution to improved communication—the next step is learning how to respond. Improving your oral communication skills depends on your ability to recognize a style and to deliver a response in that style. By listening closely, you can begin to paraphrase some of the language used by the listener. Listen for clues about the types of issues that concern others and incorporate them into your response.

Communication is affected by how people perceive the world as well as by different styles of communication. By reflecting on your own as well as other individuals' communication styles and applying what you learn, you can improve your interviewing techniques, enhance your work team, negotiate more effectively, and produce better presentations and written reports.

A World Outside the Lab

You may find it interesting that most of the occupations suggested are nonlaboratory. It is important to realize that only about 40% of baccalaureate chemistry majors who go to work in industry right out of college are hired into laboratory positions. Many others are working in occupations outside the laboratory that make use of their chemical training in different ways, such as chemical sales, finance, marketing, quality control, information systems, and technical writing. Even some of those who begin working in laboratories may eventually leave the bench to work in such nonlaboratory positions.

It is important to know your skills and interests, know the market, and think broadly. The undergraduate chemistry degree is marketable in many different occupations and work environments. Do not limit yourself!

Your Professional Values

Why should you think about values at all? Underlying all decisions and actions are our values. You have a set of values and you live your life based on those values. Remember that most of your waking hours are spent at work. It becomes very important, therefore, to have our values satisfied in the workplace. When our values are not met, or worse, not appreciated, we may find ourselves unhappy at work. When your decisions or actions are not aligned with your values, you are unhappy, uneasy, perhaps feeling blocked from your goals and aspirations. Understanding your values will help you to decide which direction to take in your career path. The better you know yourself—your skills, abilities, and values—the better prepared you will be to sell yourself to your ideal employer and to know if you want the job.

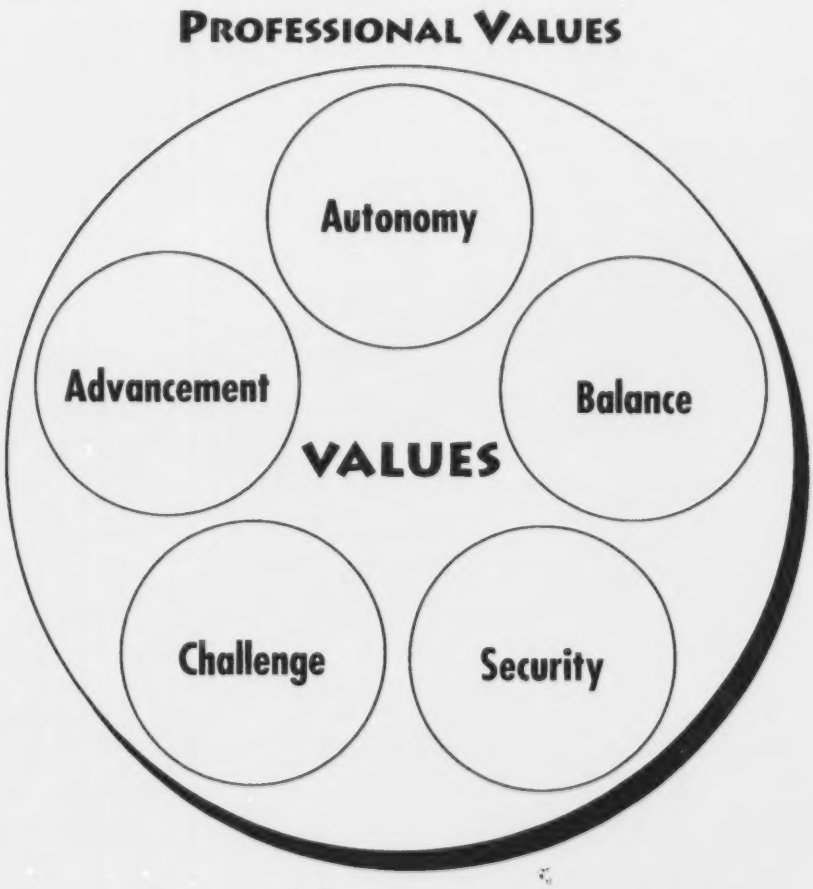
Again, your campus counseling or career center can help you with this aspect of your self-assessment: identifying your professional values. Most value assessment tools will offer a long list of concepts. For the purpose of this exercise, we have condensed professional values to five areas shown in the graphic on the right.

One of the factors most likely to contribute to a job offer is the expected "fit" of the candidate with the corporate culture. Organizations have different cultures because of the varying ideas and strategies managers use to run them. The corporate culture derives from key management's beliefs, values, and goals at a particular point in time. This is not to understate the importance of technical competence; without it, you could not carry out your job responsibilities effectively. However, it is not the only factor on which you are hired and evaluated. Your behavior on the job, which directly relates to your overall job performance, is also considered. This is where your beliefs and values play an important part. Unfortunately, many of us overlook the importance that "values matching" has for career success.

To avoid potential conflicts, try to identify your dominant personal values and the needs those values represent. There are five major values that influence the decisions we make in our careers: advancement, autonomy, balance, challenge, and security. These values are important because they help you to establish career objectives; develop and choose alternatives; and act on and evaluate the decisions you make. The order of importance of these values will shift as other aspects of your life, such as marriage, children, health, and going to graduate school, change.

To complete this aspect of the self-assessment,

1. Read through the values definitions below.
2. Rank your values in order of importance.
3. As you read through the fields and environments discussed in this chapter, ask yourself: Will my values, skills, and interests be met by a career in those areas?
4. Consider the kinds of questions you could ask on a job interview to determine whether or not your values would be met in the workplace.



Values Questions

How do you know if the company shares your values? Think about what is important to you professionally and personally on the job. What are you looking for in a position and company? Do you mind working a 60-hour week or do you want a 9-to-5 job? What are your feelings about work-related travel or relocation? How much would you accept? Do you mind working for a boss who will supervise you closely, or are you looking for one who will give you an assignment and let you run with it? Are you looking for a new challenge every day? Are you looking for a place where you can have a relatively long tenure or rapid advancement? You want to formulate some questions that you can ask in an interview: What's the turnover in the organization? What kinds of opportunities are there to develop new ideas? How much travel is required? Is there a management track and a technical track? Is there opportunity for teamwork and solo projects?

Thinking about such issues ahead of time and knowing the values that are important to you will enhance your chances of finding a job that is a good fit for you. Not only will you be happier in your work if you obtain a position to which you are well suited, but you will be able to serve your employer better as well.

Advancement

Professionals who are seeking advancement

- ☐ want to progress upward in the organization,
- ☐ want visibility and seek symbols of recognition for accomplishments, and
- ☐ will remain with a company as long as there is opportunity for growth.

Professionals who are seeking advancement look for recognition in the workplace for their accomplishments and talents. Although they often want monetary recognition, other forms of appreciation are valued as well. For example, it might be as simple as a "thank-you" for a job well done, an in-house news article on significant accomplishments, or a new job title.

Although most employees hope their careers will provide opportunities for upward mobility or developmental growth, employees driven by the need for advancement feel this drive deeply. These people are motivated largely by reaching levels of authority or decision-making power that can affect directions taken and results achieved by their organization. Such individuals, if not developing and advancing in their careers, will move to another organization where they can achieve their goals.

Autonomy

People who seek autonomy in their jobs

- ☐ prefer to do things in their own way at their own pace,
- ☐ like to set their own schedules and priorities, and
- ☐ may find organizational life restrictive.

Autonomous individuals have a strong need to work at their own pace, in their own way, and aligned with their own standards. Because of the desire for a "loose rein" on their work activities, these individuals may find organizational life too restrictive and move into a work environment that offers much more freedom. For chemists, this type of work environment can often be found in consulting and teaching. Some autonomous individuals have become successful entrepreneurs.

Balance

For people who are seeking balance in their lives

- ☐ integrating family, career, and personal interests is their top priority, and
- ☐ commuting time, work hours, and business travel are serious considerations.

Individuals who are seeking balance try to find equilibrium in all aspects of their lives. They do not want to choose between important family considerations, their career objectives, and their own self-development goals. Their lifestyle will influence decisions about such issues as relocation, family needs, work hours, and employee benefits. They place a high value on time and try to maximize it for themselves through time management and delegating work.

Challenge

Those who thrive on challenge

- ☐ define success as overcoming obstacles,
- ☐ welcome the opportunity to take on new and difficult projects, and
- ☐ like to win.

Individuals who thrive on challenge enjoy competition, and their competitive nature drives them to overcome difficult obstacles and solve difficult problems. It is not unusual for such individuals to consider salary, job titles, and work area as secondary to the challenge of the task. When these challenge-driven individuals are employed in an organization that does not offer enough hurdles, they can become bored, even irritated, with job assignments and with co-workers.

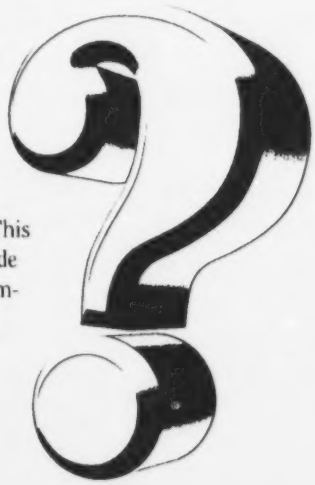
Security

People who are focused on security

- ☐ look for a company with a low turnover rate,
- ☐ carefully evaluate benefits packages,
- ☐ desire stability and usually do not challenge the system, and
- ☐ have a strong need to organize their life and plan for the future.

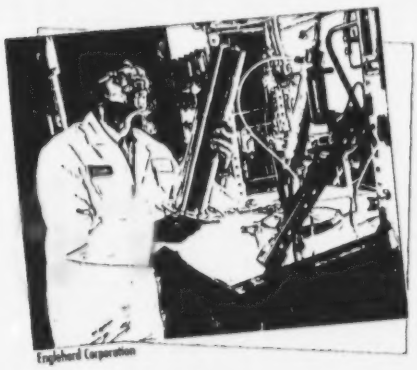
Security-driven individuals have a feeling that they must "belong." They will attempt to find employers who have a reputation for not reducing their work force. They look for a job with tenure and benefits, such as a government job. They are stable and reliable workers and will not challenge or buck the system. Their success is tied directly into the company's success. For these individuals, their jobs are defining personal statements of who they are.

Which Career Path Is for You?



Now that you have thought about your skills, interests, communication styles, and professional values, you are in a better position to consider possible career directions. Let the results of your self-assessment guide you as you explore the wide range of options available to you either in chemistry or in other fields that may draw upon your background in chemistry. This career guide and the additional sources cited in Appendix 2 provide you with a wealth of information on the many paths open to chemistry majors. Combine what you have learned from these sources with your own self-assessment to chart an exciting course for your future.

APPENDIX 2: ADDITIONAL RESOURCES



Resources Available from the ACS Career Services Department

To enhance the economic and professional status of chemistry professionals, ACS Career Services offers publications, employment services, individualized career advice, work force analyses, presentations and workshops, and videotapes to ACS members at minimal or no cost. Career Services considers special career-related requests for new programs or amendments to existing programs from special interest groups such as women, younger, disabled, and minority chemists. For more information on services, or to order products listed below, contact the ACS at (800) 227-5558, unless otherwise noted. Prices may change; please check before ordering.

Expert Career Assistance

Career Consultant Program—Volunteer consultants are available to assist you with various aspects of employment and career development (e.g., résumé preparation, career transitioning, interviewing).

Résumé Review and Career Assistance—Expert consultants provide one-on-one assistance to members to review their résumés and discuss various issues concerning their careers.

Telephone Assistance—At your fingertips, access information about salaries and employment trends.

Employment Services

ACS Job Bank—Puts many weekly postings at your fingertips, including the previous and current weeks' postings from *C&EN*. Simply surf the net—key in www.acs.org and click on the Professional Services icon. The ACS Job Bank is hotlinked to CareerPath, a searchable database of job listings from various major metropolitan newspapers throughout the country.

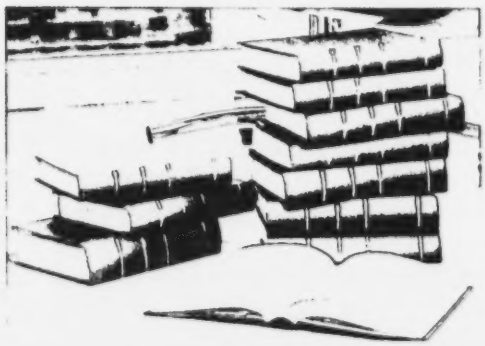
***C&EN* Situation Wanted Ads**—Employed ACS members and affiliates may place ads at $6.60 a line, per insertion, in the weekly magazine. Unemployed ACS members, affiliates, and retired members may place free situation wanted ads.

Employer Mailing List—Provides the names of companies, compiled by state, that are likely to hire chemists or chemical engineers.

Mock Interview Sessions—Provides an opportunity at ACS national meetings to be videotaped in a practice interview and receive feedback from personnel professionals.

National Employment Clearinghouse (NECH)—On-site opportunities at ACS national meetings to interview with employer representatives for actual positions available. Also conducted at regional meetings (RECH).

Professional Data Bank (PDB)—This computerized registry matches qualified candidates to specific job requirements for individual employers. The PDB is designed to give maximum exposure to the top scientific recruiters in the country. All you do is complete an information summary form (available from ACS Career Services), send it back with a copy of your résumé, and you become part of the Data Bank.



Publications

Academic Professional Guidelines—Deals with the obligations and responsibilities of individual students, professors, and administrators.

Career Transitions for Chemists—For anyone facing a career change. Discusses personal assessment, salaries, résumés, and networking. Also provides information on laboratory and nonlaboratory careers. Published by the American Chemical Society, Washington, DC, 1994. Cost is $14.95 paperback.

Careers for Chemists: A World Outside the Lab—A companion guide to *Career Transitions for Chemists*. This book presents more than 80 profiles of people who are using their training in chemistry in a variety of creative ways. These profiles highlight the paths people have taken and the factors that contributed to their career decisions; also contains summaries of the skills and characteristics needed for each of the 20 career fields covered. Cost is $15.00 plus P&H. Paperback. To order, call ACS (800) 209-0423 and ask for product C52.

Chemist's Code of Conduct—Defines a chemist's ethical standards, plus obligations to the public, science, and the profession.

Coping with Job Loss—Considers the painful anxiety and identity crisis that occur during the period of unemployment. Offers helpful suggestions for dealing effectively with the trauma of job loss.

The Interview Handbook—Discusses techniques for a successful interview.

Professional Employment Guidelines—An in-depth treatment recommending both employer and employee fair employment practices as the basis of sound professional relations.

Targeting the Job Market—Provides the step-by-step process for a successful job search, focusing on the components of targeting the job market: personal assessment, identifying job market trends, credentials, conducting the search, and networking.

Teaching Chemistry to Students with Disabilities—Developed to help professors accommodate the needs of students with disabilities in chemistry classes and labs.

Tips on Résumé Preparation—Discusses the most successful types of résumés and offers samples of each. Also includes information on preparation of a résumé.

The following brochures discuss issues that should be considered before accepting a job offer, including compensation, benefits, and career growth:

What a Chemist Should Consider Before Accepting a Government Position
What a B.S./B.A. Chemist Should Consider Before Accepting an Industrial Position
What a M.S./M.A. Chemist Should Consider Before Accepting an Industrial Position
What a Ph.D. Chemist Should Consider Before Accepting an Academic Position
What a Ph.D. Chemist Should Consider Before Accepting an Industrial Position

Workforce Analysis

Department of Career Services Bulletin—A special report providing current data on degrees and employment in the chemistry labor force—published four times a year.

Current Trends—The big picture on technology, business, economic, R&D, and hiring trends in the corporate, government, and academic worlds. Updated every five years.

Salary Survey—Analyzes the employment and salaries of ACS members who have been employed for two or more years. $150 plus sales tax.

Starting Salary Survey—Analyzes the employment and salaries of new chemistry and chemical engineering graduates, provides education data, and reviews job search techniques. $29.95 plus tax.

Women Chemists—A supplemental report on the economic status of women members at five-year intervals. Reports available from 1985, 1990, and 1995. $39.95 plus sales tax.

Workforce Report—Addresses topics of interest to the scientific professional—published three times per year.

Workshops and Presentations

These are provided at ACS national, regional, and local section meetings by request.

Effective Job Searching and Career Transitioning—Explores successful job search strategies, résumés, interviews, and winning techniques to transition within and outside of chemistry. Subtopics can be offered in two- or four-hour modules. Topics are résumé preparation, interviewing, targeting the market, and making career transitions.

Employment Outlook and Job Security—Covers the industry employment outlook and how chemists can take control of their careers.

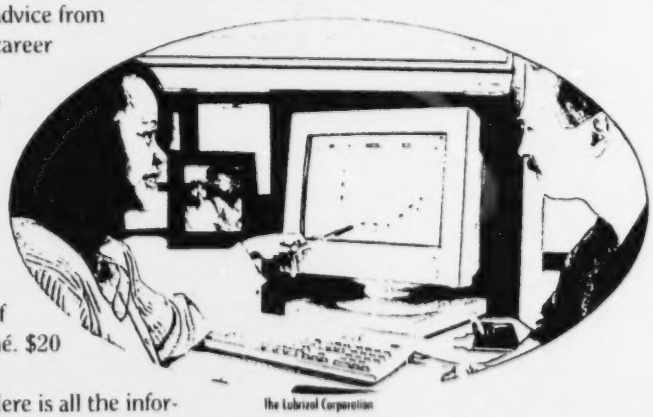
Recruiters Panel—Recruiters from different areas of chemistry discuss hiring trends and what they look for in candidates.

Videotapes

Career Transitions: Catalyst for Change—Teaches ways to take inventory of your skills, abilities, and professional values, with hands-on advice from other chemists who have successfully made career changes. $20 plus sales tax.

Formula for Success: Turning Job Leads into Gold—Presents tips on getting what you want from a job, what to list on your résumé, and how to tap into the unpublished job market. $20 plus sales tax.

Developing the Right Picture: Résumé Preparation—Presents the tools you'll need to create an accurate, sharp image of yourself for a potential employer through your résumé. $20 plus sales tax.


The Lubrizol Corporation

The Essence of a Winning Interview—Here is all the information you'll need for an interview with a potential employer: how to prepare for the interviewing process itself, interview environments, and how to manage an interview. $20 plus sales tax.

Other ACS Career Information Resources and Services

Committee on Chemists with Disabilities is dedicated to making all ACS programs and activities available and accessible to persons with disabilities; to assisting the removal of existing barriers, both physical and attitudinal, to the education and full employment of persons with disabilities; to facilitating the involvement of persons with disabilities in the chemical profession and in ACS activities; and to helping prevent the creation of additional barriers. The committee

has published the booklet, *Teaching Chemistry to Students with Disabilities*, to encourage full participation of students with disabilities in the chemistry classroom. For more information, contact the committee at ACS.

Committee on Minority Affairs is the oversight governance group within the ACS for policies and concerns relating to chemists from minority groups underrepresented in the sciences. The committee sponsors events at ACS national meetings and serves as a resource for chemists. For more information, contact the ACS Office of Minority Affairs or check the ACS Web site at www.acs.org.

Directory of Experience Opportunities is a quick source to help students in planning relevant work experience. The directory lists summer work, internships, and cooperative education programs for undergraduates. Contact ACS at 1-800-ACS-5558 to order.

Union Carbide Corporation

ACS Directory of Graduate Research (DGR) is published by the ACS Committee on Professional Training in odd-numbered years. The DGR lists schools and their departments that offer an organized curriculum leading to a doctoral and/or master's degree. The directory provides information on the degrees offered, areas of specialization, and faculty information, including a list of research publications.

Division of Professional Relations sponsors symposia at national and regional ACS meetings dealing with employment and career concerns, professional ethics, and other professional relations topics. For further information, contact the Office of Divisional Activities at the ACS headquarters office.

Careers for Chemists. An Inside Look: Chemists at Work is a videotape produced by the ACS Division of Education and International Activities that offers students a chance to view chemical professionals in their actual work settings doing their jobs. The video highlights careers in chemistry and related sciences by giving an inside look at a sample of careers held by chemical professionals at all degree levels and illustrates options available to those who obtain degrees in the chemical sciences. The one-hour video is composed of 15 four-minute segments, each focusing on a specific career area. Video crews went inside the labs and offices of bachelor's, master's, and Ph.D. degree chemists around the country and captured them performing typical duties and talking about their work, what they enjoy about their jobs, and various aspects of their professional lives. The chemists also discuss issues such as teamwork, internships, communication skills, and balancing family and career, and they offer advice to those considering careers in the chemical sciences. Closed-captioned. To order, call (800) 209-0423 and ask for product C60M. $19.95 plus $3.00 P&H.

Chemical & Engineering News (C&EN), a weekly chemical newsmagazine, is the official publication of the ACS. *C&EN* is designed to keep readers informed of developments in the world of chemistry (academia, industry, government, and news developments) and how they relate to the world at large. Each issue contains a combination of short news stories, longer trend stories, and special features on topics of broad interest to the chemical world. Lengthy articles include the Annual Salary Survey and the Employment Outlook. There is also a regular section on ACS news. *C&EN* also carries employment advertisements and situations wanted advertisements. This publication is distributed to all ACS members.

Chemical Careers in Brief is a supplement to this guide to careers in the chemical sciences and presents an overview of a variety of careers in specific areas of the chemical sciences. This 84-page book is a bound collection of 30 briefs, two to four pages long, each focusing on a different career area. The first page of each brief contains an overview of the career area and includes interviews with chemists at all degree levels working in that specific career area in various positions in industry, government, and academia. The chemists interviewed share with you their experiences with working in the field and give you an example of the types of positions held by professionals in that career area. The four-page briefs contain personal profiles of the chemists

interviewed and other professionals in the field with more in-depth descriptions of their actual work functions. The last page of each brief, called the Fact File, includes information on working conditions, educational requirements, employment outlook, salary averages, and the skills needed to pursue a career goal in the specific area. This series was developed by the ACS Division of Education and International Activities. To order the bound set of 30 briefs, call (800) 209-0423 and ask for product C-36A-S. $12 plus $3.50 P&H. (To obtain a free copy of any individual brief, call ACS at (800) 227-5558. See Sidebar on page 3 for a list of titles in the series.)

Planning for Graduate Work in Chemistry, Suggestions for Students Considering Advanced Study. A brochure designed to help you in selecting a graduate program that best meets your needs and career aspirations. It provides guidance on how to prepare for successful work in graduate school, how and when to apply for admission, and what to expect once enrolled in graduate school. For a free copy, call the ACS Office of Professional Training, (800) 227-5558.

School Reference to Experiential Programs in Chemistry lists two- and four-year colleges, universities, and graduate programs offering cooperative education, internships, study- or work-abroad programs, and service–learning programs to their chemical science students. To order, call (800) 209-0423.

Student Affiliates Program introduces undergraduates in the chemical sciences to the principles and purposes of ACS and the benefits that ACS provides. Student affiliates receive a journals option package, a subscription to *in Chemistry*, published four times a year, reduced subscription rates to ACS journals, and use of ACS Career Services. Student Affiliates also can participate in ACS national and regional activities including special programs for Student Affiliates. For further information, contact ACS at (800) 227-5558 or e-mail saprogram@acs.org.

Women Chemists Committee addresses women chemists' career concerns. WCC publishes a biannual newsletter, *Women Chemists*, featuring articles about women chemists and topics of special concern to them. WCC also sponsors symposia and special breakfasts and lunches for its members during ACS national meetings. For further information, contact the Women Chemists Committee at the ACS National Office.

Working Chemists with Disabilities: Expanding Opportunities in Science, is the second in a series of publications by the Committee on Chemists with Disabilities. The book provides factual information that illustrates, with practical examples, how people with disabilities can and do work productively in science. The book intends to pique the imaginations of science-oriented students who have disabilities and those who influence their decisions on courses of study and careers. Provides suggestions on facilitating the transition from education to employment, as well as ideas on modifying the work environments of scientists who become disabled during their careers, so they can effectively continue their chosen work. For more information, call the Committee on Chemists with Disabilities, (800) 227-5558 or visit the ACS Website at www.acs.org.

Younger Chemists Committee (YCC) represents the needs of younger chemists in the American Chemical Society at large and provides programming and services designed to enhance the careers of younger chemists. YCC produces a semiannual newsletter to inform younger chemists about upcoming events and to address issues important to them; organizes career symposia and panel discussions at ACS national meetings; and acts as a resource for information on career development.

Other Career Resources for Chemists

American Association for the Advancement of Science (AAAS) Project on Science, Technology and Disability was founded in 1975 to improve the entry and advancement of people with disabilities in science, math, and engineering. Primarily an information center, the project

links people with disabilities, their families, professors, teachers, and counselors with scientists, mathematicians, and engineers with disabilities who can share their education and career-coping strategies in technical fields. *The AAAS Resource Directory of Scientists and Engineers with Disabilities* (3rd ed., 1995) lists more than 600 individuals who are available to serve as role models and mentors. *You're in Charge* and *Find Your Future* are two career booklets offering practical advice and experience-based strategies for high school and college students with disabilities and for the advocates, advisors, and family members who work with them in seriously considering careers in science, mathematics, and engineering. Contact: Virginia W. Stern, Director, AAAS Directorate for Education & Human Resources, 1200 New York Avenue, NW, Washington, DC 20005. Tel/TDD: (202) 326-6672; fax: (202) 371-9849; e-mail: vstern@aaas.org

Alfred P. Sloan Foundation Career Cornerstone Series has funded a variety of scientific professional societies to produce career videos and CD-ROMs. See the Sloan Website for more information: www.careercornerstone.org

American Indian Science and Engineering Society (AISES) is a private, nonprofit organization that nurtures the building of community by bridging science and technology with traditional Native values. Through its education programs, AISES provides opportunities for American Indians and Alaskan Natives to pursue studies in science, engineering, business, and other academic areas. Contact: AISES, 5661 Airport Blvd., Boulder, CO 80301-2339; tel: (303) 939-0023; fax: (303) 939-8150.

Foundation for Science and Disability is an organization of disabled scientists that functions as a resource and advocacy group promoting access to science education and employment for persons with disabilities. The group publishes a newsletter and has published a book, *Able Scientists—Disabled Persons: Careers in the Sciences*, by S. Phyliss Stearner (ISBN 0-916655-00-8).

National Consortium for Graduate Degrees for Minorities in Engineering Science, Inc. (GEM) is a nonprofit corporation headquartered at the University of Notre Dame, IN, and sponsored by a consortium of university and employer members. The primary mission of GEM is to increase the participation of underrepresented minorities at the master's and doctoral levels. See the GEM Website at www.nd.edu/~gem/html

INROADS, Inc., is an organization that develops and places talented minority youths in business and industry (including chemistry) and prepares them for corporate and community leadership. They offer workshops, mentoring support, and internships. Contact: INROADS, Inc., 10 South Broadway, Suite 700, St. Louis, MO 63102; tel: (314) 241-7488.

National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE), established in 1972, is committed to the professional and educational growth of underrepresented minorities in the sciences. To that end, NOBCChE provides a number of recognition awards and scholarships to both students and professionals. NOBCChE hosts an annual national meeting and local section programs through its network of local chapters. For more information, visit their Website at www.nobcche.org

Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) is a national organization composed of science professors, industry scientists, K–12 teachers, and students. SACNAS promotes opportunities in graduate science education for Chicano/Latino, Native American, and other students in order to encourage students to reach the highest levels in their science careers. More information is available on their Website at www.sacnas.org/overview.html

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ENDNOTES

1. See "Interpersonal Skills For Workplace 2000," *in Chemistry*, Vol. 8, No. 3, January/February 1999.
2. For more information on the ACS Technical Divisions, access www.acs.org.
3. Access www.acs.org for a schedule of ACS meetings and list of local section contacts.
4. Based on *The Interview Handbook*, ACS, 1995.
5. Based on *Deal Me In*, Career Systems, Inc., 1985.
6. This section is derived from *Introduction to Type in Organizations* by Sandra Krebs Hirsh and Jean M. Kummerow. Palo Alto, CA: Consulting Psychologists Press, Inc.

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67

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